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KANSAS RIVER BASIN WATER POLLUTION INVESTIGATION

Public Health Service
Kansas City, Missouri

June 1949

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Federal Security Agency
Public Health Service
Water Pollution Control Division
Missouri River Basin Office
Kansas City, Missouri

and

Environmental Health Center
Cincinnati, Ohio
June, 1949

KANSAS RIVER BASIN WATER POLLUTION INVESTIGATION
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I

KANSAS RIVER BASIN WATER POLLUTION INVESTIGATION

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INTRODUCTION

The plan of the Missouri River Basin Inter-Agency Committee for maximum utilization of the land and water resources of the Missouri River Basin has focused attention on water quality and the need for determining the most beneficial uses of water in the basin. Consideration of beneficial water use for sanitation purposes requires information on present water quality, and information on types, sources and amounts of pollution in the streams of the Basin. An important need has been the determination of the minimum stream flows essential for public water supply and sanitation purposes.

Interested State and Federal organizations concluded that a comprehensive investigation of the water pollution problems in the Kansas River Basin should be undertaken and that the extent and nature of existing pollution, as well as the general standard of water quality, should be carefully determined and documented. After due consideration and consultation, representatives of the Corps of Engineers, U. S. Army; Bureau of Reclamation, Department of the Interior; the Kansas State Board of Health and the Nebraska State Health Department requested that the Public Health Service, Federal Security Agency, accept primary responsibility for a co-operative investigation. A Memorandum of Understanding between the interested State and Federal agencies and the Public Health Service was prepared and became effective on October 17, 1947. The complete text of the Memorandum of Understanding is given in Appendix "A".

A final report on the Kansas River Basin Water Pollution Investigation is specified in the Memorandum of Understanding. This final report supersedes the preliminary report issued in December, 1947, which dealt primarily with the Republican River Basin, and the Interim Report issued in April, 1948, which covered the entire Kansas River Basin.

In accordance with the text of the Memorandum of Understanding, the stream pollution investigations on the Kansas River Basin included, among ~~other things~~, "(a) The extent, types, and major sources of pollution; (b) A review of existing State laws in Nebraska, Kansas and Colorado, and pending legislation regarding pollution of public waters; (c) Minimum stream flows necessary below the reservoirs for public water supplies and for sanitation purposes with present and contemplated pollution; (d) Public water supply needs; (e) Possible benefits to abatement of water pollution problems by reservoir releases and the return of irrigation water; and (f) Recommendations and existing plans for pollution abatement."

The Public Health Service assigned a Sanitary Engineer to the Kansas River Basin Stream Pollution Investigation in November, 1947.

The collection and examination of stream samples began the following month with the assistance of a Sample Collector furnished by the Corps of Engineers and laboratory services provided by the Kansas State Board of Health. Additional personnel and equipment as provided for in the Memorandum of Understanding have been supplied by the interested agencies as required. At the time of maximum activity, a total of three laboratories were in operation at various points in the basin. Personnel of the U. S. Geological Survey Surface Water Division offices co-operated in the procurement of stream discharge data. Field work was completed in December, 1948.

Activities leading to this report have been carried on with the close co-ordination and assistance of the co-operating organizations. These organizations have furnished laboratory assistance; information on water supply use, on sources of pollution, on stream flows at various points; and have assisted in other important phases of the work.

The present report covers the items detailed in the Memorandum of Understanding. The first section deals with the Kansas River Basin water pollution problems in general and contains the review of state water pollution laws, information on pollution abatement programs and plans, and a summary of recommendations and conclusions. The major sub-basins are dealt with individually in detail in separate sections of the report. The appendixes present summaries of special investigations and all laboratory and flow data, and other pertinent information.

ACKNOWLEDGMENT

This investigation was conducted in accordance with a "Memorandum of Understanding Respecting Joint Program for Stream Pollution Investigations of the Kansas River Basin" (Appendix "A"), an agreement between the Corps of Engineers, Bureau of Reclamation, Kansas State Board of Health, Nebraska State Department of Health and the Public Health Service. This agreement specified cooperative activities and financial assistance to be undertaken by the various agencies. In every instance the cooperating agencies exceeded their commitments and extended their active and friendly cooperation wherever needed.

Original negotiations relative to this investigation were conducted by Sanitary Engineer Director C. H. Atkins, then District Engineer, Public Health Service, District #7, under the supervision of District Directors Estella Ford Warner and J. O. Dean. Personnel from the Environmental Health Center assisted Mr. Atkins in the organization of the survey program.

Acknowledgment is made of the excellent support of the Bureau of Reclamation - Regional Office, Region No. 7 and the Kansas River District Office, and of the Corps of Engineers - Missouri River Division and the Kansas City District Office. The assistance of the State Health Departments of Kansas and Nebraska, particularly the Divisions of Sanitation, contributed much to the success of the project. Stream flow data were secured through the close cooperation of the District Offices of the U. S. Geological Survey at Topeka, Kansas, and Lincoln, Nebraska.

As it is not practicable to indicate all contributors to this project, this opportunity is taken to gratefully acknowledge the assistance and the excellent cooperation shown by all connected with the Kansas River Water Pollution Investigation.

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1 Sample Collector, Corps of Engineers *

1 Sample Collector, Bureau of Reclamation

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1 Sample Collector, Nebraska

* Field personnel assisting with report tabulations including Sample Collectors A. P. Brenneman and Leon Hansen.

KANSAS RIVER BASIN - GENERAL SECTION

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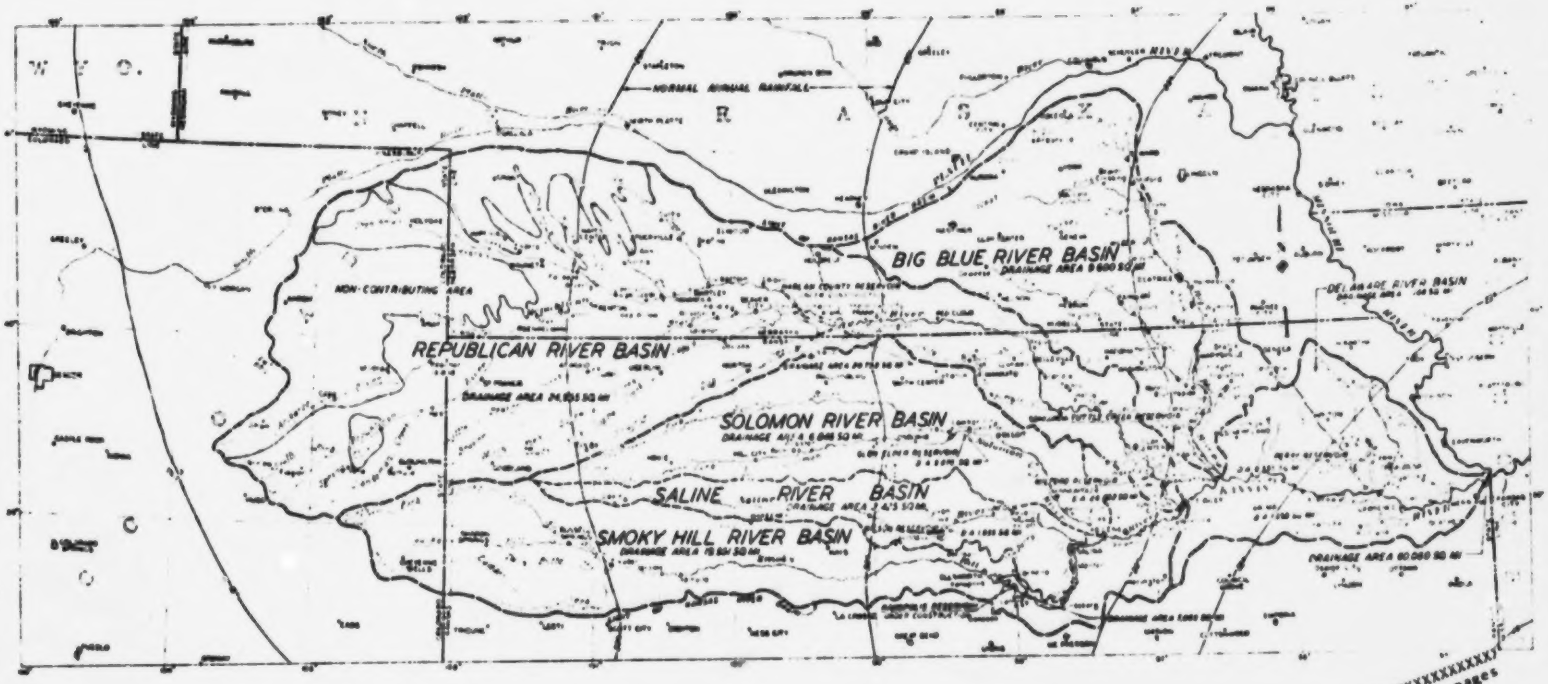
WAR DEPARTMENT



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See the following pages
for greater detail.
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KANSAS RIVER

KANSAS RIVER BASIN SHOWING MAJOR TRIBUTARIES

7a

WAR DEPARTMENT

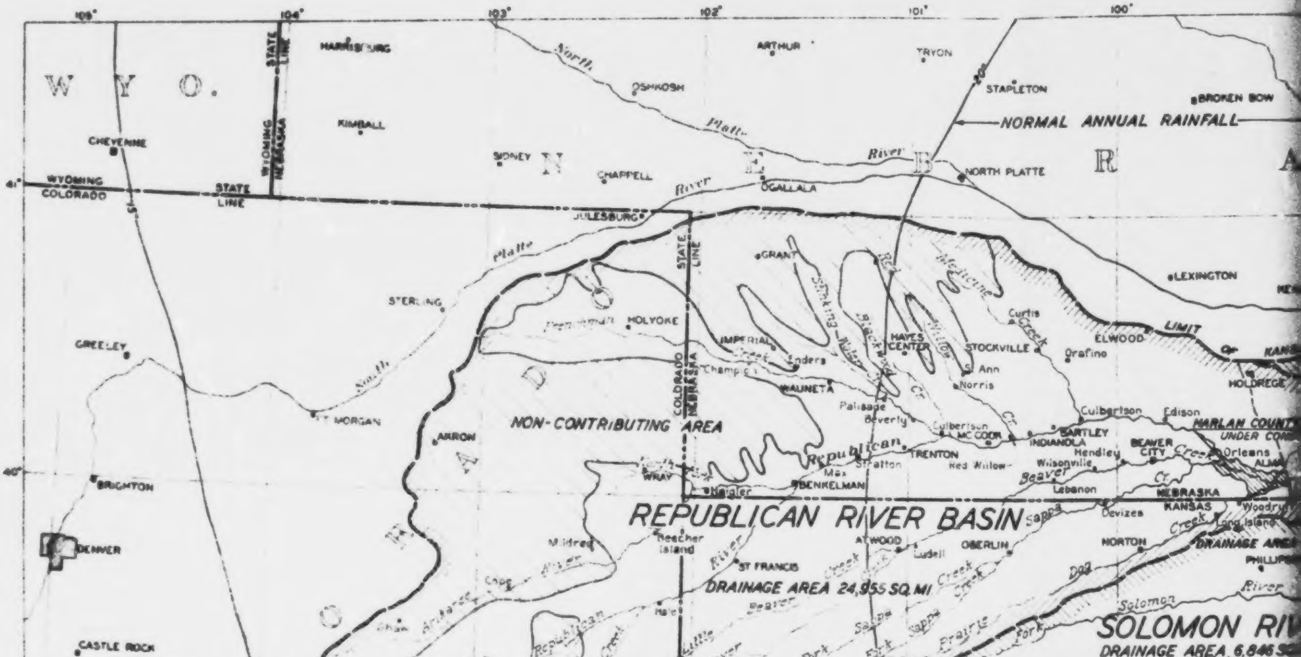

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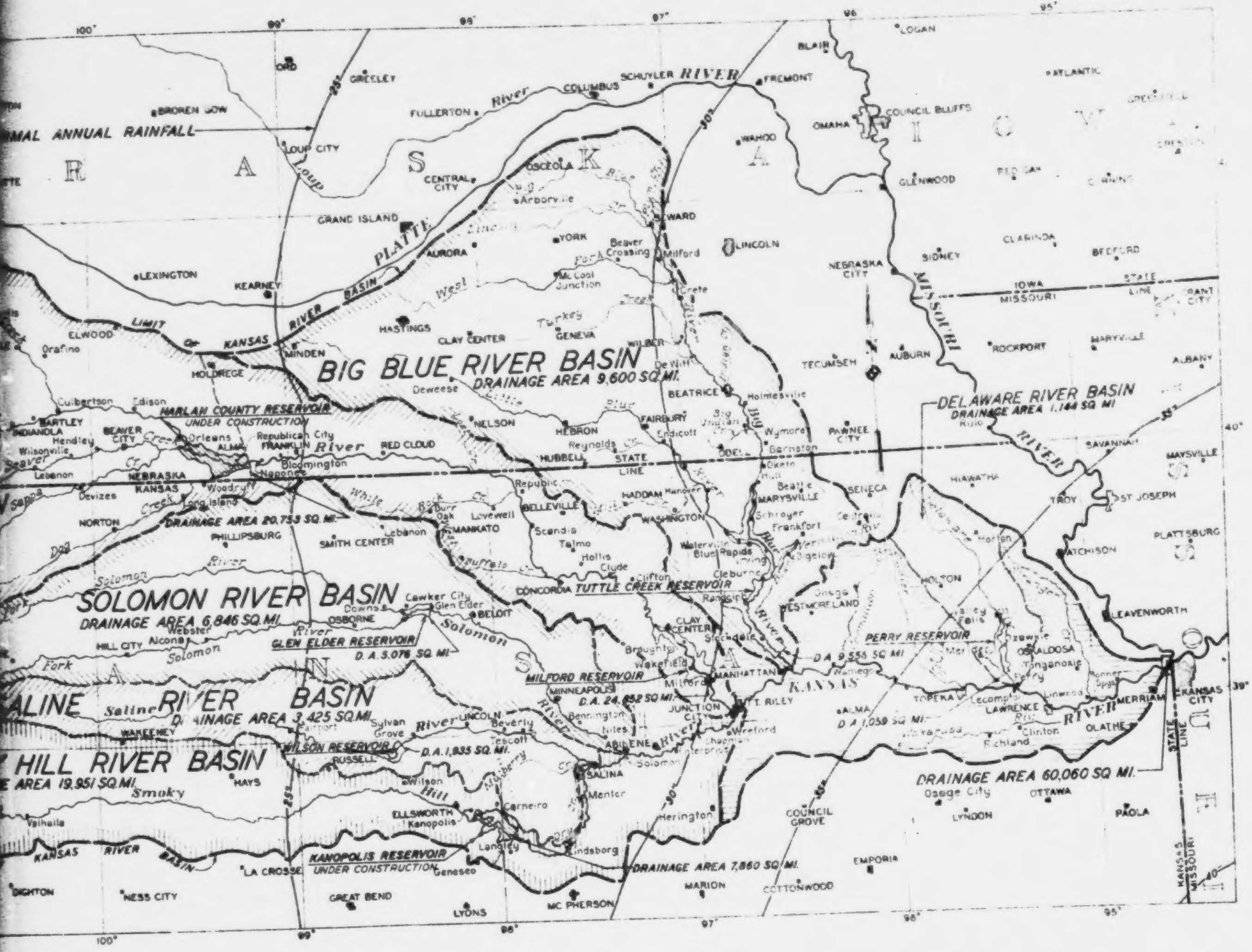
FIG. 1



REVIEW REPORT

KANSAS RIVER

KANSAS RIVER BASIN SHOWING MAJOR TRIBUTARIES

10 0 10 20 30 40 50
SCALE IN MILES

In 1 Sheet | Sheet No 1 | Scale: see graphic

KANSAS CITY, MO
MARCH 1947

CORPS OF ENGINEERS
KANSAS CITY DISTRICT

Submitted W. J. Hare Senior Engineer
Recommended D.H. McCloskey Head Engineer
Approved Colonel Corps of Engineers

Compiled by H.M.L. | Traced by C.W.S. | Checked by A.C.F. | Transmitted with report dated 15 MARCH 1947 | File No A-20-48

B

7a

KANSAS RIVER BASIN - GENERAL SECTION

DESCRIPTION

The Kansas River Basin lies between the basins of the Platte and Nemaha Rivers on the north, and the Arkansas and Marais des Cygnes or Osage Rivers on the south. Its entire area is approximately 60,060 square miles, of which roughly 16 per cent is in Colorado, 28 per cent is in Nebraska and 56 per cent is in Kansas. (Fig. 1).

The principal rivers of the Kansas River system are the Kansas, the Big Blue, the Republican, the Smoky Hill, the Solomon, and the Saline (Table 1). The Saline and Solomon Rivers are tributaries of the Smoky Hill River. The Kansas River itself is formed by the confluence of the Smoky Hill and Republican Rivers at Junction City, Kansas. The Big Blue River discharges directly into the main Kansas River. All of the large tributaries of both the Smoky Hill and the Kansas Rivers enter from the north. The southern tributaries are all small because the divide that separates the Kansas River Basin from the basins to the south runs close to the Smoky Hill and Kansas Rivers.

The Kansas River itself is a comparatively short stream which flows in a general easterly direction from Junction City, Kansas, to its confluence with the Missouri River at Kansas City, Kansas.

The principal sub-basins that make up the Kansas River Basin are described individually in following sections of this report.

RESERVOIRS AND DIVERSION PROJECTS

Table 2 presents a summary of reservoir projects in the Kansas River Basin, from information furnished by the Bureau of Reclamation and the Corps of Engineers. The 34 reservoirs are those remaining from the consideration of a somewhat greater number of possibilities. It is to be noted that of this number, 16 are authorized or under construction. Additional reservoirs may eventually be added from those under investigation or for future consideration. Table 3 lists the dams and diversions by sub-basins. (See Fig. 2).

Table 1 - Kansas River Basin - Principal Tributaries and their Drainage Areas

Stream	Miles Above Mouth		Drainage Area Square Miles
	Kansas River	Tributary	
Kansas River			60,060
Main Stem Kansas River			5,554
Big Blue River	142.5		9,600
Republican River	169.2		24,955
Smoky Hill River	169.2		19,951
Solomon River		85.4	6,846
Saline River		106.5	3,425

Table 2

Kansas River Basin

Summary of Reservoirs

Sub-Basin	Number of Reservoirs			Capacities, 1000 Acre-Feet			
	Total	Authorized	Under Construction	Flood Control	Irrigation	Conservation	Total
Main Kansas and Minor Tributaries	4	-	-	187 (1)	0	173 (1)	360 (1)
Big Blue	1	1	-	1,600	0	680	2,280
Republican	22	5	4	1,673 *	386 *	372 *	2,431 *
Smoky Hill	2	-	2	580	118.6	103.6	802.2
Solomon	3	3	-	382	401	51	834
Saline	2	1	-	145	224.9	19	388.9
Total	34	10	6	4,567	1,130.5	1,398.6	7,096.1

(1) Perry Reservoir only

* Excludes reservoirs under investigation

Table 3

Kansas River Basin

Reservoirs and Diversion Projects

Basin, Dams and Diversions	Location by River Miles (1)	
	Main Stems	Tributaries
Main Kansas River Basin		
Linwood Dam (Proposed)	K.- 33.6	St.C.-4.7
Clinton Dam (Proposed)	K.- 40.7	W.-31.8
Perry Dam (Proposed)	K.- 63.3	D.-7.7
Onaga Dam (Proposed)	K.-116.9	V.-23.9
Big Blue River Basin		
Tuttle Creek Dam (Proposed)	B.- 12.3	
Republican River Basin		
Milford Dam (Proposed)	R.- 19.4	
Scandia Diversion Dam	R.-125.6	
Lovewell Dam (Proposed)	R.-136.5	W.R.C.-13.1
Republic Diversion Dam	R.-146.9	
Superior-Courtland Diversion Dam	R.-177.6	
Harlan County Dam (Under Const.)	R.-236.2	
Woodruff Dam (Proposed)	R.-239.8	P.D.C.-21.7
Prairie Dog Diversion Dam		P.D.C.-53.2
Norton Dam (Proposed)		P.D.C.-69.3
Beaver City Dam (Proposed)	R.-258.0	S.C.-12.3 Be.C.-21.9
Sappa Creek Dam (Proposed)		S.C.-40.3
Oberlin Dam (Proposed)		S.C.-106.6
Cambridge Diversion Dam	R.-308.4	
Medicine Dam (Under Const.)	R.-309.6	M.C.-9.5
Red Willow Diversion Dam	R.-329.4	
Indianola Diversion Dam	R.-329.6	R.W.C.-14.9
Red Willow Dam (Proposed)		R.W.C.-18.5
Blackwood Dam (Proposed)	R.-350.2	Bl.C.-9.8
Culbertson Diversion Dam	R.-351.6	Fr.C.-23.0
Stinking Water Dam (Proposed)		Fr.C.-23.5 St.W.C.-40.0
Enders Dam (Under Const.)		Fr.C.-51.9
Culbertson Dam (Proposed)	R.-365.0	
Benkelman Diversion Dam	R.-392.0	
Benkelman Dam (Proposed)	R.-393.6	S.F.R.- 3.4
St. Francis Dam (Proposed)		S.F.R.-36.0
Bonny Dam (Under Const.)		S.F.R.-54.9
Stratton Dam (Proposed)		S.F.R.-85.1
Rock Creek Dam (Proposed)	R.-407.0	Ro.C.-2.0
Pioneer Dam (Proposed)	R.-421.7	A.-12.1
Wray Dam (Proposed)		N.F.R.-24.1
Smoky Hill River Basin		
Kanopolis Dam (Under Const. - Essentially Complete)	S.H.-207.8	
Cedar Bluff Dam (Under Const.)	S.H.-362.4	
Solomon River Basin		
Glen Elder Dam (Proposed)	S.-156.1	
Alton Diversion Dam	S.-171.6	S.F.S.-47.1
Webster Dam (Proposed)		S.F.S.-90.2
Kirwin Dam (Proposed)		N.F.S.-66.6
Saline River Basin		
Wilson Dam (Proposed)	Sa.-120.3	
Russell Dam (Proposed)	Sa.-169.3	

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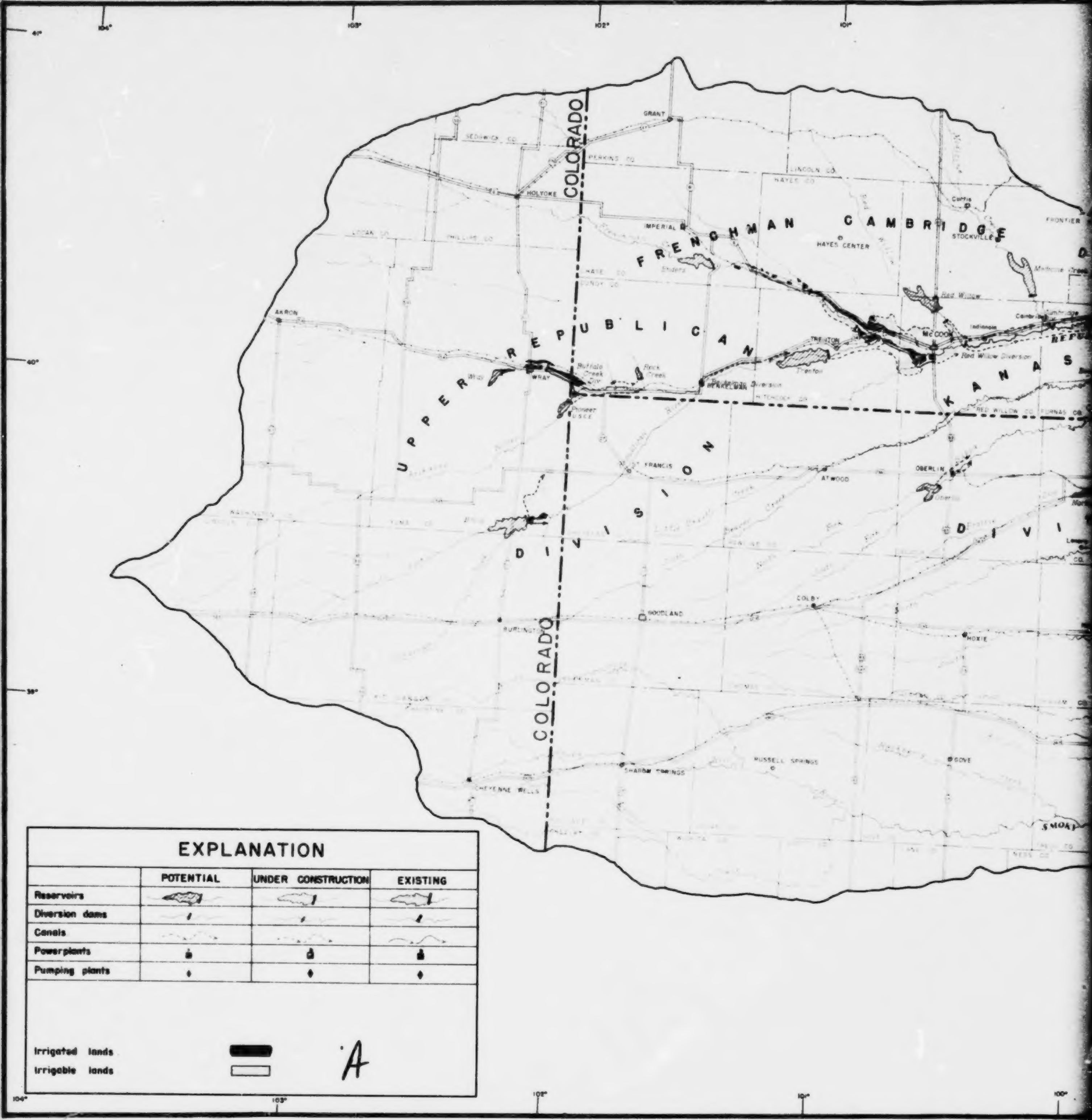
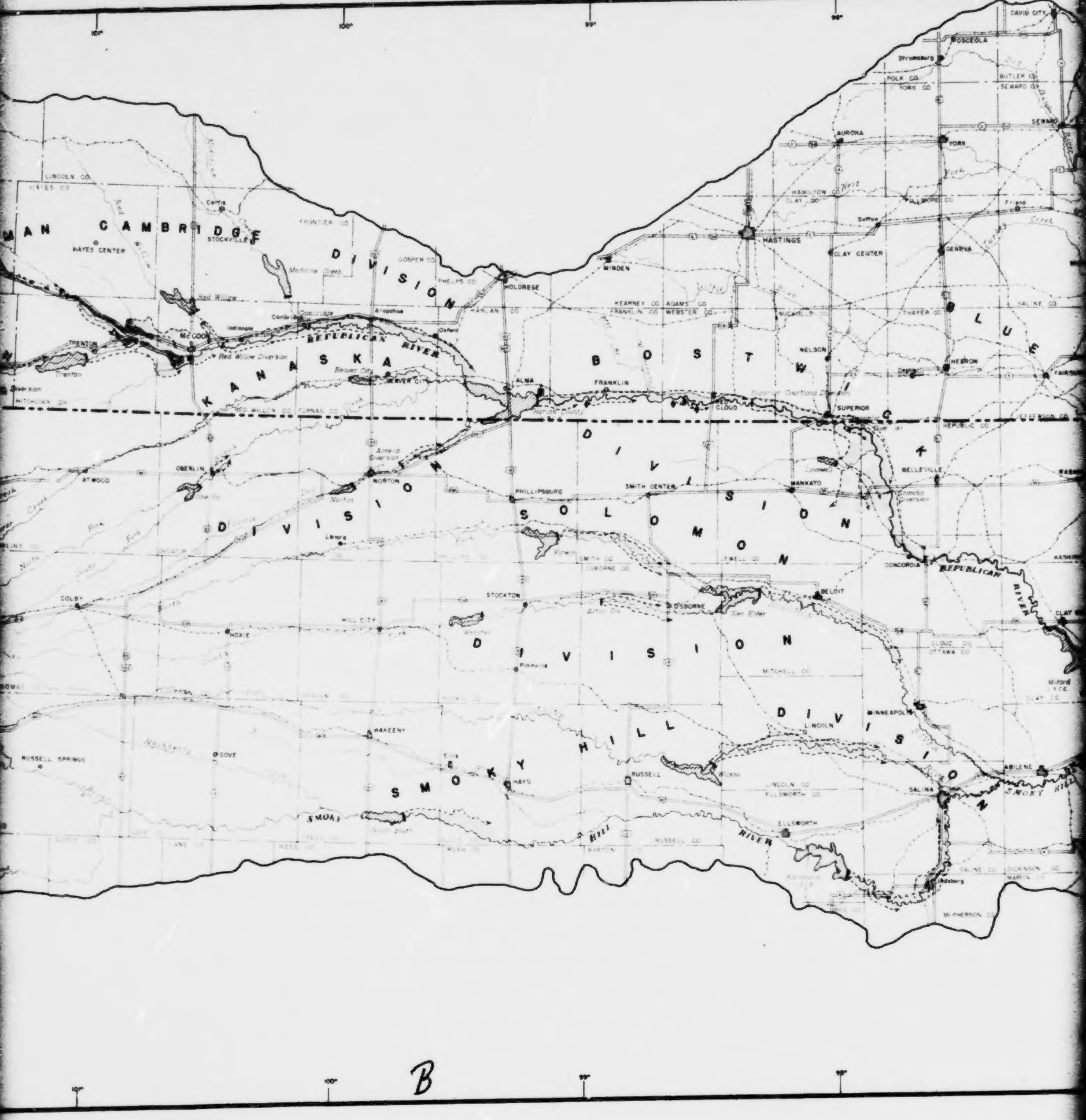
(1) For Stream Designations see Appendix "I".

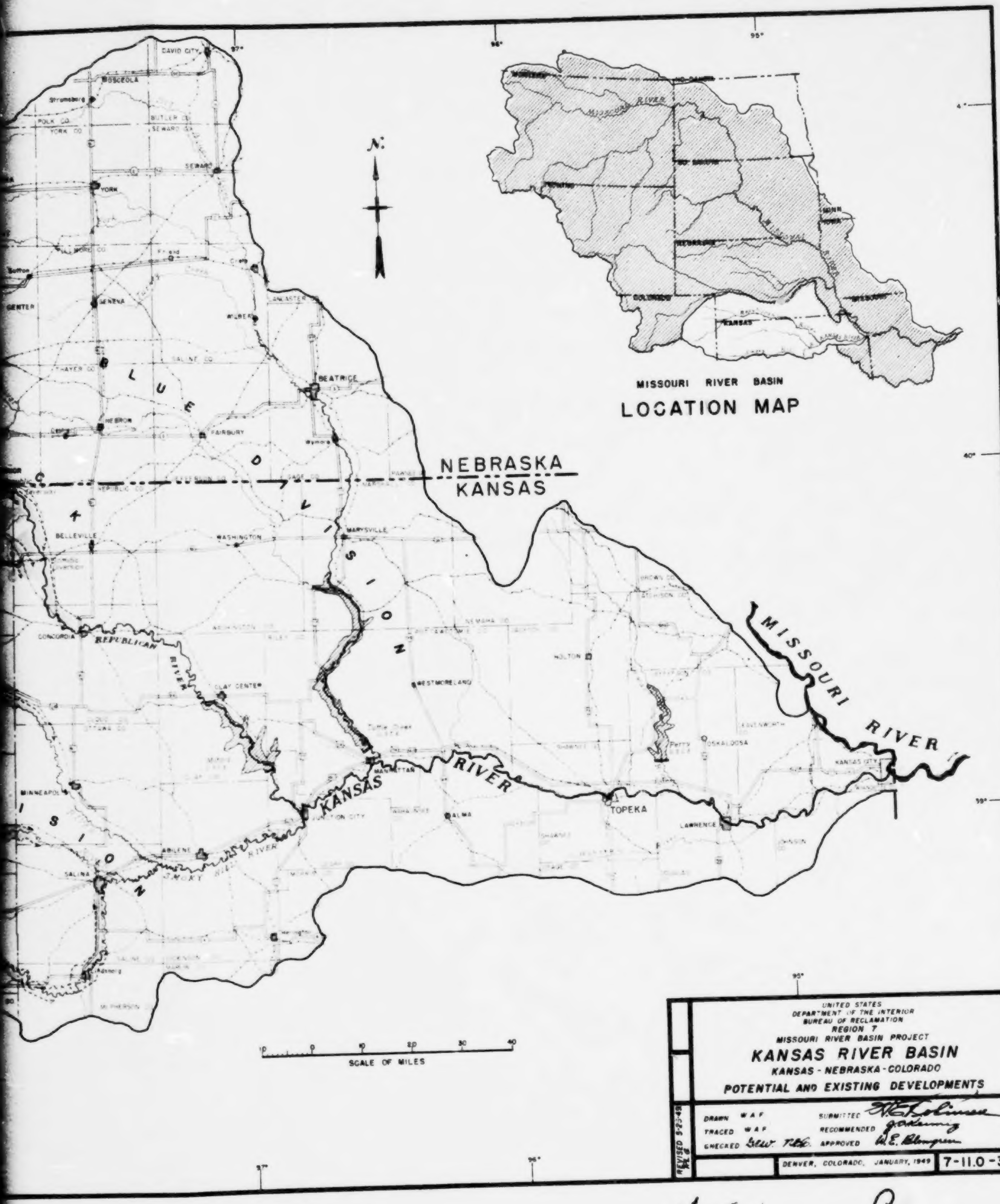


104°
103°
102°
101°
100°
41°
40°
39°
COLORADO
COLORADO
COLORADO
UPPER REPUBLICAN DIVISION
FRENCHMAN CAMBRIDGE
KANSAS
DIVISION
GRANT
SEDGWICK CO.
PERKINS CO.
HOLYOKE
LINCOLN CO.
HAYES CO.
Curtis
STOCKVILLE
FRONTIER
IMPERIAL
HAYES CENTER
LOGAN CO.
PHILLIPS CO.
CHASE CO.
DUNDY CO.
Enders
Red Willow
Medicine Creek
AKRON
TRENTON
McCOOK
Indianola
Cambridge
Red Willow Diversion
Trenton
Wray
WRAY
Buffalo Creek
Rock Creek
BENKELMAN
Benkelman Diversion
HITCHCOCK CO.
RED WILLOW CO.
FURNAS CO.
Pioneer
U.S.C.E.
ST. FRANCIS
ATWOOD
OBERLIN
Oberlin
WASHINGTON CO.
YUMA CO.
RAWLINS CO.
GOODLAND
COLBY
BURLINGTON
HOXIE
KIT CARSON CO.
SHERMAN CO.
THOMAS CO.
RUSSELL SPRINGS
GOVE
SHARON SPRINGS
CHEYENNE WELLS
WALLACE CO.
WICHITA CO.
NESS CO.
SMOKY
EXPLANATION
POTENTIAL
UNDER CONSTRUCTION
EXISTING
Reservoirs
Diversion dams
Canals
Powerplants
Pumping plants
Irrigated lands
Irrigable lands

A


101°
100°
99°
98°
CAMBRIDGE DIVISION
KANASKA DIVISION
BOSTWICK DIVISION
BLUE
SOLOMON DIVISION
SMOKY HILL DIVISION
REPUBLICAN RIVER
SMOKY HILL RIVER
DAVID CITY
OSCEOLA
Stromsburg
POLK CO.
BUTLER CO.
YORK CO.
SEWARD CO.
SEWARD
AURORA
YORK
HAMILTON CO.
CLAY CO.
FILLMORE CO.
Friend
Sutton
HASTINGS
CLAY CENTER
GENEVA
MINDEN
HOLDREGE
KEARNEY CO.
ADAMS CO.
FRANKLIN CO.
WEBSTER CO.
NUCKOLLS CO.
THAYER CO.
SALINE CO.
NELSON
HEBRON
FRANKLIN
RED CLOUD
SUPERIOR
ALMA
Harlan County
LINCOLN CO.
HAYES CO.
Curtis
FRONTIER CO.
STOCKVILLE
HAYES CENTER
Medicine Creek
GOSPER CO.
PHELPS CO.
Red Willow
HARLAN CO.
Cambridge
Arapahoe
Indianola
McCOOK
Oxford
TRENTON
Trenton
Red Willow Diversion
Beaver City
BEAVER CITY
HITCHCOCK CO.
RED WILLOW CO.
FURNAS CO.
Diversion
Superior Courtland Diversion
REPUBLIC CO.
BELLEVILLE
Lovewell
MANKATO
Courtland Diversion
OBERLIN
ATWOOD
Almena Diversion
NORTON
Norton
PHILLIPSBURG
SMITH CENTER
Oberlin
Lenora
Kirwin
SMITH CO.
OSBORNE CO.
JEWELL CO.
CONCORDIA
BELOIT
STOCKTON
OSBORNE
Glen Elder
COLBY
HILL CITY
HOXIE
Webster
CLOUD CO.
OTTAWA CO.
MITCHELL CO.
Plainville
CLAY CENTER
Milford
CLAY CO.
MINNEAPOLIS
LINCOLN
WAKEENEY
Ellis
HAYS
RUSSELL
Wilson
LINCOLN CO.
ELLSWORTH CO.
RUSSELL SPRINGS
GOVE
Hackberry
Cedar Bluff
SALINA
ABILENE
ELLSWORTH
Kanopolis
Lindsborg
LANE CO.
NESS CO.
RUSH CO.
BARTON CO.
RUSSELL CO.
SALINE CO.
DICKINSON CO.
MARION CO.
McPHERSON CO.
RICE CO.

B



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
REGION 7
MISSOURI RIVER BASIN PROJECT

KANSAS RIVER BASIN

KANSAS - NEBRASKA - COLORADO

POTENTIAL AND EXISTING DEVELOPMENTS

DRAWN W.A.F. SUBMITTED
TRACED W.A.F. RECOMMENDED
CHECKED APPROVED W. E. Blomgren

REVISED 5-25-49

DENVER, COLORADO, JANUARY, 1949

7-11.0-39

11-a C

Smoky Hill River - Kanopolis Dam
Reservoir Filling (7-17-48)

Republican River - Cambridge Diversion Dam
(7-15-48)

Smoky Hill River - Reach Below
Kanopolis Dam (7-17-48)

Republican River - Irrigation Diversion
Structures at Cambridge Diversion Dam
(7-15-48)

Reproduced from
best available copy.

REVIEW OF STATE WATER POLLUTION LAWS AND PROGRAMS

In accordance with the provisions of the "Memorandum of Understanding" (Appendix "A") there is presented a critical review of the water pollution laws of Colorado, Kansas and Nebraska, together with information regarding pending legislation. For general information on the subject of State water pollution control legislation and suggested criteria for component parts see Appendix "B".

In addition there is presented a brief review of each State's water pollution control program.

STATE OF KANSAS

Summary

Kansas has detailed and effective water pollution control statutes. Responsibility is delegated to a single State agency - the Kansas State Board of Health. There is no specific statutory authority for the development of a comprehensive program in the field of water pollution; nevertheless, substantial progress has been made in abatement and prevention of pollution. Statutory deficiencies lie principally in the field of municipal financing of pollution abatement works and the maintenance and operation of such works. The State's water pollution control program has been, in general, quite effective. Lack of funds has limited the scope of certain phases of the program, however. At a number of places, untreated wastes are still discharged into the waters of the State.

Administrative Authority

Administrative authority and responsibility for water pollution control are vested in a single State agency - the Kansas State Board of Health. The State Health Officer whose statutory title is "Secretary and Executive Officer" and the Engineer, both appointed by the Board of Health, represent this body and form the nucleus of the water pollution control organization. The principal administrative responsibility falls upon the Engineer and pollution control activities are carried out by the Division of Sanitation of which the Engineer is Director. The Board meets quarterly but may be called into special session. Sections 74 - 901, et seq and 65 - 164, et seq, General Statutes of Kansas, provide for the organization of the Board, the election of a Secretary and Executive officer, the appointment of an Engineer, general jurisdiction in public health matters, and authority for control over pollution of the waters of the State.

Definitions

Sewage - Section 65 - 164 of the statutes provides a broad definition which includes industrial wastes.

Waters of the State - The definition given in Section 65 - 162 includes all surface waters of the State and also applies to ground waters.

Powers and Duties

Comprehensive Program; Cooperation - There is no specific statutory authority for the development of a comprehensive program for the prevention, control and abatement of water pollution throughout the State nor is there any specific authority for cooperation with other States, the Federal Government and industries in matters of pollution control. However, cooperative activities of this nature have been carried on extensively in the past and will no doubt continue. For all practical purposes effective cooperation exists. A notable example is the cooperative agreements that have been renewed from year to year since 1934 between the Kansas State Board of Health and the U. S. Bureau of Mines for the study of oil field brine disposal. The State Board of Health, the U. S. Geological Survey and the State Geological Survey have been cooperating for more than ten years in a study of ground water resources of the State. The State Board of Health and the Public Health Service have cooperated on several water pollution studies including the one covered by this report.

Members of the State Board of Health's engineering staff cooperate with the State Division of Water Resources and the Health Department is represented on important water use and control planning committees. Sections 65 - 171d and 55 - 1003 of the General Statutes provide for cooperation between the State Board of Health and the Forestry, Fish and Game Commission and the State Corporation Commission.

Considerable progress has been made over the years in the development of a State-wide plan for pollution control and in the carrying out of this plan.

Investigations - Section 65 - 164 of the State statutes authorizes the Board of Health to make investigations of the pollution of any of the waters of the State upon receipt of complaint by the mayor of any city, a county health officer or a local board of health. This statute also authorizes the Board to make such investigations "upon its own motion". The original statute related only to public health but 65 - 171a amends this to include "stream pollution found to be detrimental to animal or aquatic life". This statute should be further broadened to include pollution detrimental to other water uses; e.g.industrial, recreational, etc.

Section 65 - 170 which provides for the appointment of the "engineer of the State Board of Health" also states that "it shall be the duty of the engineer to investigate and report upon all matters relating to sewerage and the pollution of the waters of the State . . . . and to make . . . special investigations . . . of methods of sewage disposal".

Section 65 - 171e specifies that investigations under the provision of this act "shall be made by the Division of Sanitation of the State Board of Health . . . and all fees collected shall be turned into the State treasury for the benefit of said Division . . ." The Engineer is Director of this division.

Section 65 - 171c authorizes the appointment or employment of technical advisors. The investigative powers of the State Board of Health are believed to be adequate.

Stream Standards and Classification - No specific authority is provided for the adoption of standards and the classification of waters according to use. However, Section 65 - 171d provides authority for regulations for the purpose of controlling stream pollution and it is reasonable to assume that this provides ample authority for stream classification and the adoption of standards. Section 65-170 is also applicable.

Rules and Regulations - Section 65 - 171d provides authority for the adoption of rules and regulations provided approval of the Forestry, Fish and Game Commission is obtained, governing the disposal of domestic sewage and industrial wastes. This statute was amended in 1945 to provide authority for better control of oil field brine by the State Board of Health. This section also authorizes the Board of Health to fix fees to cover the cost of services rendered under these rules and regulations. Provision is made for hearings.

Permits - Section 65 - 164, et seq, as amended in 1947, provide authority for the permit system for the disposal of sewage from cities, sanitary districts and sewerage companies. Exceptions are "the discharge of sewage from any public sewer system owned and maintained by a municipality or sewerage company . . . in operation on the twentieth day of March, 1907." However, the exception does not apply if the sewer system has been extended subsequent to this date; so, for all practical purposes, there are no exceptions. All cities are now operating under the permit system. Permits may stipulate the conditions under which the sewage discharge shall be permitted; i.e., treatment requirements may be specified. In the event of an appeal regarding a permit the court may fix the terms upon which a permit shall be granted. Permits are signed by the Secretary of the Board, the Governor, and the Attorney General and are subject to revocation. These permit statutes do not provide for the issuance of permits to other than sewerage companies, municipalities and county or township sewer districts. They should be broadened to include all sources of water pollution.

Orders for Pollution Abatement - Section 65 - 164, et seq, provide the State Board of Health ample authority to order the abatement of pollution found to be harmful to the public health or animal or aquatic life. Section 65 - 165 provides for the change or revocation of sewage discharge permits by the Board of Health after an investigation, notice and hearing. A new permit may be granted later if desirable. Section 65 - 164 provides for appeal from the Board's orders within 30 days to the district court in the county in which the pollution occurs. The order may be approved, modified or set aside by the court.

The Secretary or the Engineer, or both, may act for the Board when it is not in session. When confirmed by the Attorney General and the Governor, their decisions have the same force and effect as though made by the Board. (Section 65 - 170).

As far as oil field brines are concerned, Sections 55 - 1003, 65 - 171d, et seq, and Senate Bill 168 which was passed in 1949 and becomes law after July 1, 1949, grant the State Board of Health considerable power to abate and, of equal importance, to prevent oil field brine pollution of the waters of the State. Under authority granted to it the State Board of Health has promulgated rules and regulations relating to the oil field brine problem.

There is some division of authority in oil field brine disposal matters between the State Board of Health and the State Corporation Commission. However, the health department's powers are believed to be adequate and it is doubtful if this division of authority is of much importance.

The State Board of Health has instituted injunction proceedings on several occasions in connection with oil field brine pollution. This procedure has proven quite effective.

Plans and Specifications - The rules and regulations of the State Board of Health and certain statutes require the submission of plans and specifications for sewage and industrial waste works, including revisions and extensions. The Board has ample authority to promulgate such rules and regulations and the majority of plans for such projects are reviewed by the engineering staff prior to construction. Section 65 - 166, Laws of 1907, Chapter 382, required the submission of information regarding sewer systems operating at the time of the passage of this act in 1907.

Federal Water Pollution Control Act - The State Board of Health is authorized to cooperate with the Federal Government in connection with its general health program. However, there is no specific legislation in force or pending relative to State activities in connection with the Federal Water Pollution Control Act (Public Law 845).

Enforcement

Permits - These can be revoked and Section 65 - 167 authorizes an initial fine of $500 and a further penalty of $50 per day for discharging sewage without a permit.

Orders - It is the "duty of the person, company, corporation, institution or municipality to whom (the) order is directed to fully comply with said order . . ." Failure to comply can be punished by fines ranging from $25 to $100 for each offense and each day of failure constitutes a separate offense. (Sections 65 - 164 and 65 - 169)

Suits - Suits may be brought in the name of the State of Kansas by the Attorney General. Penalties and fines are to be paid into the school fund. (Section 65 - 170)

Regulations - Fines ranging from $25 to $250 per day are possible. See Sections 65 - 169 and 65 - 171f. Section 65 - 171f was amended during the 1949 session. This amendment increased the maximum fine from $100 to $250 per day.

Sanitary Districts

Various statutes authorize the formation of sanitary sewer districts in unincorporated areas in townships and counties. These districts are authorized to construct, maintain and operate works for the collection, treatment and disposal of sanitary sewage and may vote bonds for construction and levy taxes for maintenance and operation. For all practical purposes, once formed, these districts have municipal powers as far as matters relating to sewage collection, treatment and disposal are concerned.

Statutes Governing Financing of Pollution Abatement Works

As far as Kansas is concerned, important water pollution control statutory deficiencies in the past have been those governing the financing of the construction, maintenance, and operation of municipal sewage treatment works. To a lesser, but still important, extent, this is true today.

A serious deficiency in the past lay in the $100,000 cost limitation for sewage treatment works imposed by Section 12-621 of the General Statutes for all cities having a population of under 80,000. In one instance a few years ago this statute operated to prevent a city willing and able to construct a secondary treatment plant from doing so. Because of the $100,000 limitation the city had to limit construction to primary treatment. Other cases could be cited. This limitation was removed by a 1947 amendment.

In another instance a city was desirous of improving and enlarging an existing sewage treatment plant. Consulting engineers were retained and a cost estimate prepared. However, no statute could be found that would allow the City to spend the money for the enlargement and it was necessary to wait until the next session of the legislature when passage of a bill authorizing the improvements was obtained.

Another serious deficiency is the lack of generally applicable sewer service charge legislation. Only a limited number of Kansas cities have this authority. Repeated efforts to secure passage of such legislation have met with failure. This is an outstanding weakness. Efforts to secure passage of such legislation should continue. Lack of this authority has had, and will continue to have,adverse effects on the general water pollution control program insofar as municipal sewage plant construction, maintenance and operation are concerned. Under existing municipal tax statutes some cities cannot raise more than about one-fourth of the cost of operation of their existing sewage treatment plants. When plant enlargements are needed these cities are in an even worse position. Sewer service charge legislation is permissive in character and only those cities which require the funds need make use of a statute of this type.

Water Pollution Control Program

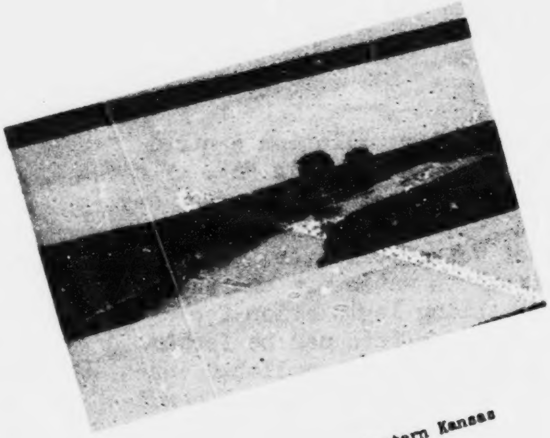
The Kansas State Board of Health's water pollution control program,while deficient in the respect that not enough trained personnel have been available to make the extensive investigations and inspections needed, has been, in general, quite successful. It has followed the pattern of as frequent meetings with responsible city and industrial officials as possible, inspections, training of sewage plant operators, and the stimulation of a desire on the part of the public for clean streams. Enthusiasm, technical background and personality of the health department's personnel have contributed much to the program. In only a few cases has it been necessary to resort to formal orders or legal action to secure compliance. The State Board of Health appears to have the respect of cities, industries, and citizens in general and this is of as much importance as the legal authority granted by statute as far as accomplishment is concerned. It is fortunate, however, that fairly strong statutes are available for use in recalcitrant cases. The influence of a body of law is felt even though the legal machinery created by it may be seldom called upon to function.

An indication of the success of this State's program is given by the fact that on a State-wide basis 70 per cent of the sewered population is served by sewage treatment plants. Of equal interest is the fact that of the cities having sewers approximately 75 per cent have sewage treatment plants. These figures compare favorably with similar national statistics.

The effects of this State's oil field brine disposal control program are dealt with in detail in various sections of this report. The State Board of Health in cooperation with oil companies and the U. S. Bureau of Mines pioneered in this field of pollution control and the results of its research and investigation have been beneficial not only in Kansas but wherever oil brine disposal is a problem. The outlook is for continued successful work in this activity, which is self-financing.

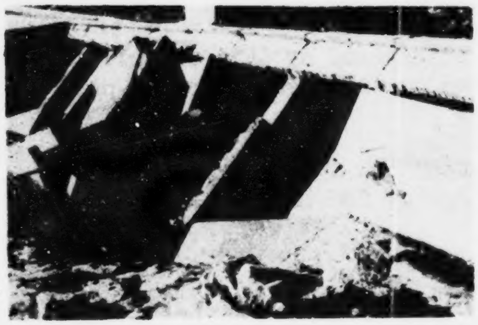
In addition to the statutory handicaps already mentioned, the principal deterrents to the State's water pollution control program have been lack of appropriations, and consequent excessive personnel turnover in former years, and difficulties in securing well trained personnel in recent years.

A stable, smooth functioning pollution control organization can be built to serve the State but only if adequate funds are provided.

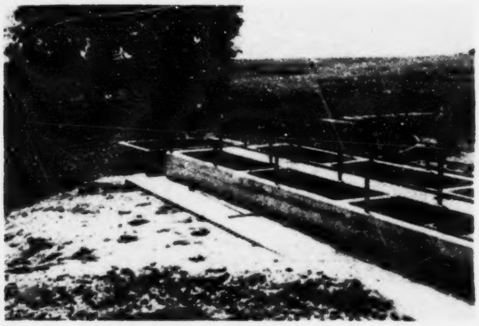


Smoky Hill River - Western Kansas
at U. S. Hwy. No. 83

Oil Well Brine Lagoon - North
of Wakeeney, Kansas



Saline River - Flood
Damage to Quinter Dam



Oakley, Kansas Sewage
Treatment Plant

STATE OF NEBRASKA

Summary

Nebraska should enact comprehensive water pollution control legislation based on the criteria contained in Appendix "B". The existing State water pollution laws are inadequate for present day needs. The powers of the State Health Department should not be limited to the public health aspects of water pollution. They should apply to all pollution detrimental to water use and there should be no division of authority. Enabling legislation for cities appears to be adequate. Sanitary districts can be formed. The State's water pollution control program has accomplished considerable improvement but much remains to be done. Serious handicaps to this program have been lack of personnel and inadequate laws. Both of these deficiencies should be corrected.

Administrative Authority

Nebraska does not have a comprehensive water pollution law and there is no statutory requirement for the development of a broad water pollution control program or the administrative enforcement thereof. Comprehensive water pollution control legislation should be enacted as soon as possible. The only statutory authority for water pollution control in Nebraska is given in Section 81-602, Revised Statutes of Nebraska which states, "The Department of Health shall have general supervision and control over matters relating to public health and sanitation . . . . ."

The State Health Department is authorized by this statute to adopt reasonable rules and regulations as will best serve to promote sanitation throughout the State.

The Attorney General has ruled that the State Health Department is the Water Pollution Control Agency for the State.

Definitions

Definitions of the terms "sewage", "industrial wastes", "other wastes", etc. should be included in comprehensive water pollution legislation adopted for Nebraska (See Appendix "B").

Section 37-516, Revised Statutes of 1943, defines "refuse" as all substances harmful to aquatic life and forbids its discharge into the waters of the State. However, this statute exempts corporations, villages, and cities of the second class discharging sewage or refuse prior to August 21, 1931 and is not of great value to a general pollution control program.

Powers and Duties

Comprehensive Program; Cooperation - The powers and duties of the State Health Department appear to be quite limited as far as water pollution is concerned. The functions of the Sanitation Division of the Health Department are principally advisory and educational.

The Nebraska State Health Department, while not specifically authorized to do so by statute, does cooperate with various Stat and Federal agencies in connection with water pollution control problems. Such cooperation should be authorized by statute.

Investigations - The State Health Department conducts water pollution investigations under the very general authority granted to it by the statutes. More specific authority would be desirable (See Appendix "B").

Stream Standards and Classification - There is no specific authority for classification of waters according to use or the adoption of stream standards. Section 81-602 might possibly be construed to grant this authority, but specific legislation is needed.

Rules and Regulations - General health department authority for the adoption of rules and regulations is contained in Section 81-602 but specific authority in the field of water pollution control is needed (See Appendix "B").

Permits - No permit system is now in operation. Such a system is considered administratively desirable and should be included in future water pollution control legislation.

Orders for Pollution Abatement - There is no specific authority provided by statute. Presumably, however, the State Health Department could act if there was a serious public health hazard. Specific authority is needed. This authority should cover all forms of pollution and should not be limited to public health problems alone. It should include, as well, pollution detrimental to all other water uses (See Appendix "B").

Plans and Specifications - Submission is required by the State Health Department rules and regulations for systems serving more than 25 persons. No mention is made of plans for industrial waste treatment plants, however.

Federal Water Pollution Control Act - There is no specific statutory authority for cooperation with the Federal Government in connection with Public Law 845.

Division of Authority - There is some division of authority and responsibility between the State Fish and Game Agency and the State Health Department. The State Fish and Game Agency may take action through county attorneys to secure abatement of pollution harmful to aquatic life. In the enactment of comprehensive water pollution control legislation, a single state agency should be designated and its powers should be broad enough to include this and all other types of water pollution problems.

Enforcement

Penalties are provided for failure to comply with the Health Department's rules and regulations. Fines vary from $15 to $100 for each offense. As far as water pollution is concerned enforcement provisions appear to be deficient. This phase of a comprehensive pollution law is important and should be included in future legislation.

Sanitary Districts

Section 31-701, et seq, Revised Statutes, Supplement, 1947 indicate that sanitary districts may be formed and that such districts may provide for the construction and maintenance of necessary sewage works. (Certain areas may not be included in such districts.) General obligation bonds up to 10 per cent of the assessed valuation of taxable property may be issued. Revenue bonds may also be used to finance such projects and in such cases the 10 per cent limit does not apply.

Statutes Governing Financing of Pollution Abatement Works

All villages and cities may issue "mortgage bonds" (Section 18-502). These bonds do not impose any general liability upon the municipality and are secured by the property; e.g., the sewage works, and revenues derived therefrom. This is the equivalent of sewer service charge financing and is undoubtedly of considerable value to the municipalities in financing sewage treatment works.

All cities and villages are authorized by Section 18-501, et seq, to own, construct, equip and operate sewage works within or outside the city or village. They may condemn the lands needed, levy taxes, issue bonds, or as previously noted, mortgage bonds in accordance with statutory provisions. Cities and villages may also adopt rules and regulations governing the use of sewers and treatment plants and charges for the use of same. If the charge is not paid, the city or village may recover by action of assumpsit or the charge may be certified to the tax assessor and assessed against the property served.

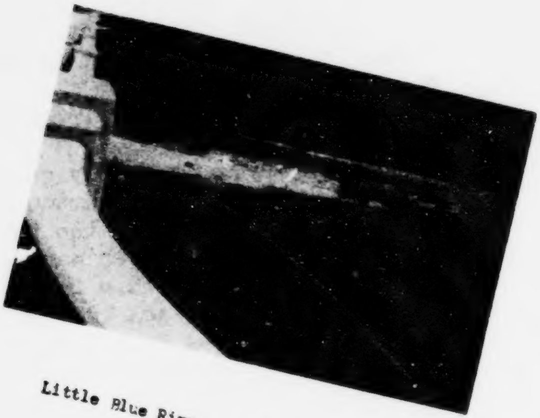
Municipal finance laws have never retarded the progress of water pollution abatement in Nebraska.

Water Pollution Control Program

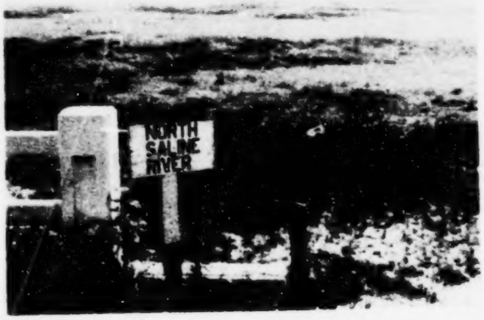
Nebraska has a fairly good record in water pollution control and the State Health Department enjoys the confidence of State and city officials, and the public at large. Undoubtedly the State's program has been seriously handicapped by inadequate statutory backing. This is a definite need. Another serious handicap has been lack of a sufficient number of competent engineers on the State Health Department's staff. Present key personnel are experienced and competent but cannot handle the work throughout the State unaided. Funds should be provided for increasing the engineering staff assigned to pollution control work.

Of the total Nebraska population served by sewer systems, about 46 per cent are tributary to sewage treatment plants. Of the cities having sewer systems, about 56 per cent provide treatment. Similar national statistics indicate that about 63 per cent of the sewered population are served by treatment facilities and that about 61 per cent of the sewered communities provide treatment.

Republican River - Bridge
South of Alma, Nebraska



Little Blue River - U. S. Hwy. No. 36



North Saline River - Dry Stream in
Western Kansas at U. S. Hwy. No. 83

Republican River Below Concordia, Kansas

STATE OF COLORADO

Summary

The State Department of Public Health has been designated as the water pollution control agency for Colorado, but it shares responsibility with other public authorities. Its powers are limited to the public health aspects of water pollution control. More detailed and broader statutory authority would be desirable and this authority, when provided, should be centered in a single State agency. Colorado cities have adequate sewage works financing laws. Sanitary districts can be formed. The State Health Department has been active in the field of water pollution control but rapid turnover in key engineering personnel in recent years and lack of personnel and funds have tended to limit the intensity and scope of this program. The outlook is for increased activity in this field, however.

Administrative Authority

Chapter 208 of the 1947 Session Laws of Colorado gives considerable responsibility in the field of water pollution control to the State Department of Public Health. No specific statutory provision is made for the administrative establishment of a water pollution control authority but in one section of this act, cited as the "State Department of Public Health Reorganization Act of 1947" the Department of Public Health is given the power and duty to establish and enforce minimum general sanitary standards for, among other things, "The effluent of sewerage systems and 'trade wastes' discharged upon the land or into the surface or ground waters . . . . ."

The State's Attorney General has given the opinion that the State Department of Public Health is the water pollution control agency for the State.

The Department of Public Health has established an Environmental Sanitation Division in order to meet its responsibility in the field of water pollution control and in other sanitation fields.

Definitions

The only definitions found in the reorganization act are in Section 5, paragraph 21, where the terms "minimum general sanitary standards" and "standards" are defined. The phrase "minimum general sanitary standards" means the "minimum reasonably consistent with protection of the public health". The word "standards" means "standards reasonably designed to promote and protect the public health". The term "trade wastes" used in Section 5, paragraph 7, is not defined and a definition of it is needed. This should make clear whether or not "trade wastes" include all mining wastes. Definitions of other terms are also needed. (See Appendix "B")

Powers and Duties

Comprehensive Program; cooperation - There is no specific statutory authorization for a comprehensive water pollution program although such would be desirable.

Inasmuch as the Department of Public Health may wish to cooperate with other States and the Federal Government, specific authority for cooperation in matters of water pollution control should be granted. (The State health authority has general statutory authorization for cooperation with the Federal Government.) The State Department of Public Health has and is now cooperating with the Public Health Service in water pollution investigations.

Investigations - Authority for investigations may be inferred from Section 5, paragraph 7 of the reorganization act previously cited and from other sections of the same act.

Stream Standards; classification - The reorganization act authorizes the Department of Public Health to establish and enforce "minimum general sanitary standards. . . as to the quality of the effluent of sewerage systems and trade wastes discharged upon the land or into ground or surface waters". The suggested criteria given in Appendix "B" give the State water pollution control agency the statutory power and duty to set standards of water purity and to classify waters according to their particular uses. In contrast to this the setting of a "minimum general sanitary standard" may prove exceedingly difficult and once set might prove so rigid as to be a serious detriment to adequate water pollution control. The statute should be changed to avoid this difficulty. It should also be noted that by definition these minimum standards apply only to the protection of the public health and thus limit the activities of the Health Department which has been designated the State water pollution control agency.

Rules and Regulations; hearings - The reorganization act of 1947, Section 6, paragraph 4 authorizes the Department of Public Health to adopt rules and regulations as necessary to carry out the provisions and purposes of the act. This statute also states that all rules and regulations in force at the time of passage of the act, shall remain in full effect. All rules and regulations adopted have the force of law.

The State health authority is also specifically authorized by statute to hold hearings, administer oaths, subpoena witnesses, and take testimony in all matters relating to the powers and duties vested in it.

Permits - The permit system is not required by statute but the rules of the State health department require application to and approval by the health department before new sewage works or alterations to existing works are undertaken. Inasmuch as the system of permits for the discharge of sewage, etc. into the waters of the State is administratively desirable, this authority should be provided by statute (See Appendix "B").

Orders for Pollution Abatement - The State health authority is authorized by statute to issue orders as may be necessary to carry out the provisions and purposes of the previously cited reorganization act. Apparently, however, the State health authority is limited to matters relating to public health. As far as a comprehensive water pollution control program is concerned this is a serious deficiency which should be corrected.

Plans and Specifications - Submission of plans and specifications for all type of sewage works including additions or alterations is required by the State health authority's rules and regulations. These apply to municipalities, districts, corporations, companies, institutions and persons as long as a population of more than 25 is served. Specific reference should be made to separate industrial waste treatment plants.

Federal Water Pollution Control Act - There is no specific authority for State cooperation with the Federal Government in connection with the Federal Water Pollution Control Act (Public Law 845). However, the reorganization act does provide general authority for cooperation with the Federal Government. The State health authority may accept, use, disburse and administer all federal aid or other property, services and moneys allotted to it for State or local public works or public health functions. Agreements as may be required as a condition precedent to receiving such funds may be entered into if not inconsistent with Colorado law and after approval by the Attorney General.

Division of Authority - The State health authority, although designated the State water pollution control agency, shares responsibility for water pollution investigations and control with the State Game and Fish Commission which is responsible for mine tailing pollution and the City and County of Denver. The latter is given jurisdiction over "the South Platte River, Bear Creek and any of their tributaries above the mouth of Clear Creek." (Section 257, et seq, Chap. 48 Colorado Statute annotated, 1935) This is substantially the Denver public water supply catchment area.

It is desirable to have all pollution control work centered in one State water pollution control agency (See Appendix "B"). Inasmuch as the State health authority already has been granted considerable authority, the powers of this agency should be broadened so that it exercises control over all types of water pollution problems throughout the State.

Enforcement

The State health authority's orders, rules and regulations are backed by fairly strong penalty provisions which include both fines and imprisonment plus liability for expenses incurred by the health authorities in removing "any nuisance, source of filth or cause of sickness." Provision is made in the statutes for judicial review of decisions by the State health authority in the event any person is aggrieved by such a decision.

Section 257, et seq, Chapter 48, Colorado Statutes Annotated, 1935 provides penalties for obstruction or pollution of water courses, lakes, etc.

Sanitary Districts

There is statutory authority for the formation of sanitary districts in Colorado.

Statutes Governing Financing of Pollution Abatement Works

In general, Colorado cities have adequate authority for issuance of revenue or general obligation bonds for the financing of sewage works.

Water Pollution Control Program

While the State health department has been active in this field, many cities and industries still discharge untreated or inadequately treated wastes into the waters of the State. Surface water resources are limited and a further complication results from extensive irrigation water use. A number of critical stream pollution problems exist. There has been considerable turnover in key sanitary engineering personnel in recent years. This plus lack of sufficient personnel and funds and inadequate statutory authority have limited the extent of the program in the past. Fortunately, the situation is now improved and the outlook is for a concerted effort by the State Department of Public Health toward better stream sanitation within statutory limitations.

Of the total Colorado population served by sewer systems, about 86 per cent are tributary to some type of sewage treatment plant. However, of the total number of communities having sewer systems, only about 49 per cent provide treatment. The population served figure compares very favorably with a similar national figure of about 63 per cent. The per cent of sewered cities served by treatment plants is substantially less than the national value of about 61 per cent. The significance of these figures is that much pollution abatement promotion work needs to be done in the smaller cities in Colorado.

SURVEY METHODS

The investigation of water pollution and water utilization in the Kansas River Basin included:

(a) Field investigations to secure most recent and accurate information regarding (1) water supplies and water utilization, (2) sources of pollution including sewage treatment, sewage discharge and industrial wastes.

(b) Sampling program and laboratory determinations to secure various physical, chemical and bacteriological information on stream conditions as a means of correlating actual stream characteristics with sources of pollution.

(c) Hydrometric determinations to secure stream discharge data at time of sampling so that laboratory results could be evaluated quantitatively with sources of pollution.

(d) Assembly and review of existing information.

FIELD INVESTIGATIONS

Field surveys of water supplies and sources of pollution were conducted in most instances by Sanitary Engineers of the respective State Health Departments. In special cases laboratory studies supplemented these investigations, particularly when unknown factors required evaluation. Data were submitted to the Kansas River Basin Office for review, and for calculation or checking of population equivalents of waste discharge in the case of industrial pollutional loads. In all instances, completed tabulations were given final checking and approval by the State Health Departments concerned.

Water Supply

The water supply data collected for each municipality included the source of supply, treatment if any, population served, and average consumption. 1948 population estimates were employed in most cases to arrive at the population served by water systems. Industrial use of water, particularly in the Main Kansas River Basin where large volumes are used and established by water rights, was investigated.

Sources of Pollution

Domestic Sewage - For each municipality, the data gathered included the sewered population, type and degree of treatment if any, and receiving body of water. The percentage B.O.D. removal by treatment plants, where records or supplemental information was not available, was taken as 35% for primary treatment and 75% for secondary treatment. However, the judgment and experience of the investigating engineer were depended upon to evaluate treatment processes where inspection indicated exceptionally good results, an overloaded plant, inefficient or faulty operation. In a few questionable instances grab samples or composites from a 24-hour period were analyzed to provide actual efficiency records.

Industrial Wastes - All industrial establishments discharging a significant pollutional waste were investigated to secure information in sufficient detail to permit a quantitative evaluation of the pollutional load based on population equivalents. Survey forms completed on industries included the following information: type of industry, location, magnitude of operation (with seasonal variation), water supply, quantity of raw materials, quantity of finished products, treatment of wastes if any, and receiving body of water.

These reports were submitted by the various States to the Basin Office for review and final calculation. The industrial waste was expressed as population equivalents based upon 0.167 pounds per day of 5-day 20°C, Biochemical Oxygen Demand (B.O.D.) per person.

Population equivalent unit values were obtained primarily from the Industrial Waste Guides, Ohio River Pollution survey and occasionally supplemented by figures from other sources. In the case of poultry dressing establishments, the paucity of reliable information made it desirable to establish the relationship between population equivalent and production during this survey which was done by conducting detailed studies over the operating cycle of several plants (Appendix "E").

The principal industries encountered in this area were slaughtering, meat packing, dairies, canneries, poultry dressing, oil production, oil refineries, soap manufacturing and paper mill.

Sewered Population Equivalent - To arrive at the pollution produced by a given community the sewered population equivalent of the industrial wastes was added to that of the sewered population and shown as the total sewered population equivalent. The waste discharged was the sewered population equivalent minus any treatment either by the municipality, industries, or combined.

SAMPLING POINTS

Establishment of Sampling Points

Stream sampling stations were established at water supply intakes, above and below sources of known or suspected pollution, in the vicinity of locations of dams and diversions, at points where other water uses might develop, and at suitable points at the mouths of tributaries. In areas where significant pollution was expected intermediate points were added. In most instances single samples were collected but on large streams cross-sectional sampling at quarter or third points was the practice, depending upon channel characteristics.

Conveniently located bridges were utilized wherever possible for sampling locations. In the absence of bridges, suitable walk-in points were selected necessitating the use of boats, in some cases, to assure representative sampling.

Points were designated by description and river miles above mouth of the stream. (Appendix "I").

Number of Sampling Points

A total of 353 stream points were sampled regularly. The number of individual samples from each point varied from two to thirty and averaged over ten per point.

Sampling Points by Basins

Basin	Main Stem	Tributaries	Total
Missouri River	4	-	4
Kansas River	25	24	49
Republican River	60	65	125
Big Blue River	31	50	81
Smoky Hill River	28	15	43
Solomon River	13	23	36
Saline River	15	-	15
Total	176	177	353

Sampling Procedure

Sampling was conducted to secure a representative portion of the stream in question. The sample was drawn from the main channel or channels, and if at all possible, from mid-depth. A copper depth sampler was employed in most instances. With shallow streams, a special pole-type sampler was used.

Dip samples were collected when the water was too shallow to use the pole sampler. The wide, extremely shallow, stream beds at some of the sampling stations carried a flow of several c.f.s. and rather than omit the point, dip sampling procedure was resorted to in a few cases.

Data Obtained by Sample Collector

The sample collector recorded the time of day to the nearest minute when a sample was collected, determined the temperature of the water to the nearest degree Centigrade, and gaged the stream as described in the section on stream discharge data. The sample collector also recorded as "remarks" any unusual stream conditions, noted the presence of possible sources of pollution, road conditions encountered, and other pertinent information.

Transportation of Samples

Samples were transported in special carrying cases in the bed of the truck or car. During warm weather the containers, which were regular cold drink insulated coolers, were iced. In one end of the box a metal frame was installed that would hold a 25-pound cake of ice in place while the balance of the box was filled with a frame with thin slatted partitions for dissolved oxygen, bacteriological and biochemical oxygen demand sample bottles. Samples were placed in the cooler as soon as collected and remained there until ready for analysis. In the winter samples were carried in the car or cab of the truck to prevent freezing.

It was the practice to collect samples in the morning and have them at the laboratory by 2:00 p.m. at the latest so that analyses could be initiated with a minimum elapsed time.

Special Studies

Special studies required advanced planning so that necessary personnel for gaging, frequent sample collecting, compositing, and other work were available without serious interruption of the regular survey schedule. These studies were made in close cooperation with the State Health Departments, who also furnished personnel for the projects. Excellent cooperation was received in all cases from the industry involved. Several poultry dressing establishments and sewage plants were investigated while special studies were undertaken to evaluate stream characteristics.

Extensive chloride studies of two rivers in the central part of Kansas were carried on as semi-independent surveys. A truck was equipped for this purpose and supplied with necessary reagents and solutions at the Smith Center laboratory. The samples were collected and analyzed in the field, usually working from the mouth upstream. Where a tributary warranted additional study, this was done before proceeding with the main stream.

LABORATORY OPERATIONS

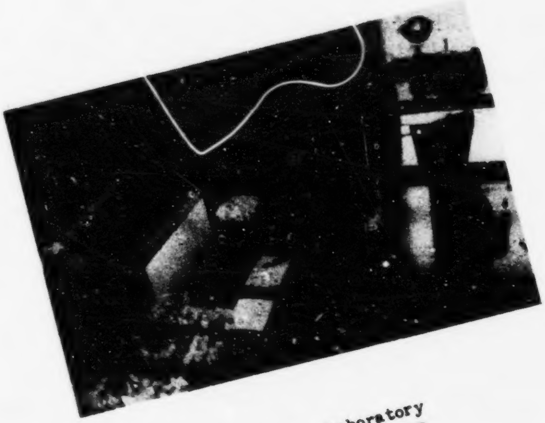
Three laboratory units conducted routine analyses during the survey: the Kansas State Board of Health laboratory at Lawrence, Kansas; a fixed laboratory established at the Smith Center Water Plant, Smith Center, Kansas; and a mobile trailer laboratory.

Laboratory Resources

Lawrence Laboratory - Samples collected from the lower portion of the Basin were analyzed at the Kansas State Board of Health laboratory, located in Marvin Hall, University of Kansas, Lawrence, Kansas. This laboratory operated for the duration of the survey receiving the first samples on December 17, 1947 and the last December 22, 1948. The regular Health Department chemical and bacteriological laboratory personnel and facilities were utilized and the survey analyses made in addition to routine Health Department work. One sample collector operated out of this laboratory which handled an average of more than 20 stream samples per week. Some special oxygen studies and industrial waste examinations were also made at this laboratory.

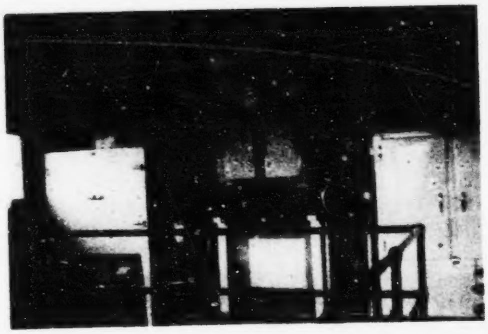
Smith Center Laboratory - The building and equipping of a fixed central laboratory at the Smith Center Water Plant, Smith Center, Kansas, was started in February, 1948. Sampling and analytical work was initiated March 29, 1948, and the laboratory was in continuous operation through December 28, 1948. Personnel included a chief chemist, a laboratory assistant and two sample collectors over most of the period.

Equipment and supplies for the Smith Center laboratory were furnished by the Public Health Service, the Kansas River Basin Water Pollution Investigation and the Kansas State Board of Health. Utilities were provided by the Kansas State Board of Health.



Smith Center Laboratory
Bacteriological Section

Smith Center Laboratory
Chemical Section



Smith Center Laboratory
(Left to Right)
37°C Incubator
Gas Sterilizing Oven
Pressure Autoclave
20°C Incubator

Mobile Trailer Laboratory Unit at
Location - Geneva, Nebraska

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best available copy.

Regular routine chemical and bacteriological analyses were made at the Smith Center laboratory. In addition, determinations such as solids, ammonia, nitrite and nitrate nitrogen and phenols were made on sewage plant, industrial waste and other special samples.

The Smith Center laboratory was used as a base for supplies and equipment for the mobile units and sample collecting cars. The trailer laboratory was furnished with necessary reagents, chemicals and standard solutions as needed; all standard solutions and reagents were prepared and tested before shipment to the mobile unit.

Trailer Laboratory - A mobile laboratory unit, equipped and manned for routine chemical and bacteriological analyses, was operated ih the field from June 1 to the latter part of October. The first location was at Benkelman, Nebraska where the collection and analysis of samples was started June 3, and discontinued August 6. The sampling area covered was the upper Republican River and tributaries.

The mobile laboratory then moved to location at Geneva, Nebraska, and started operations in the Big and Little Blue River Basins on August 19, 1948. Besides the regular chemical and bacteriological analyses, several special dissolved oxygen studies on selected stream reaches and examination of sewage plant samples were made.

The mobile unit was returned to Smith Center at the completion of this detail late in October where routine chemical and bacteriological analyses were made in the trailer during November, while the fixed laboratory was engaged in special studies. The normal complement of the mobile unit was one chemist-bacteriologist, a laboratory aide, and a sample collector.

Schedule of Operations

The routine program resulted in 4,310 samples; the following table shows the number of routine stream samples collected and analyzed each month by the respective laboratory units:

MONTH	LAWRENCE 12/17/47	SMITH CENTER 3/29/48		TRAILER 6/3/48	TOTAL
Dec. 1947	53				53
Jan. 1948	64				64
Feb. 1948	45				45
Mar. 1948	94	31			125
Apr. 1948	106	309			415
May 1948	68	250			318
June 1948	75	244		241	560
July 1948	104	220		264	588
Aug. 1948	111	312		114	537
Sept. 1948	102	238		207	547
Oct. 1948	77	256		94	427
Nov. 1948	92		155		247
Dec. 1948	83		301		384
				Total	4,310

The schedule of operations is shown in Table No. 4

Total Number of Determinations

A total of 4,310 samples were collected from regular established stream points on which over 34,500 determinations were made (see Figure 3). In addition to the above, several dissolved oxygen studies were made in selected stream areas, sewage treatment plants were sampled and industrial wastes studied. The special chloride determinations were made in the field as collected, so were not enumerated or recorded in the regular laboratory log books.

Laboratory Tests

Routine laboratory tests included dissolved oxygen, biochemical oxygen demand, pH, temperature, turbidity, alkalinity, chloride and coliform group organisms. Other tests made on sewage, industrial waste or special samples were settleable and suspended solids, phenols, and ammonia, nitrite and nitrate nitrogen.

Temperature - The temperature of a water controls the oxygen solubility and thus the saturation level of dissolved oxygen in the stream. The rate of natural purification and bacterial growth is increased or diminished with higher or lower temperatures, respectively.

Turbidity - Turbidity of water is due to suspended matter. This suspended material may be particles that will settle out on standing or may be colloidal in nature. Turbidity measurement gives an approximation of the amount of silt or suspended material

Table 4

KANSAS RIVER BASIN

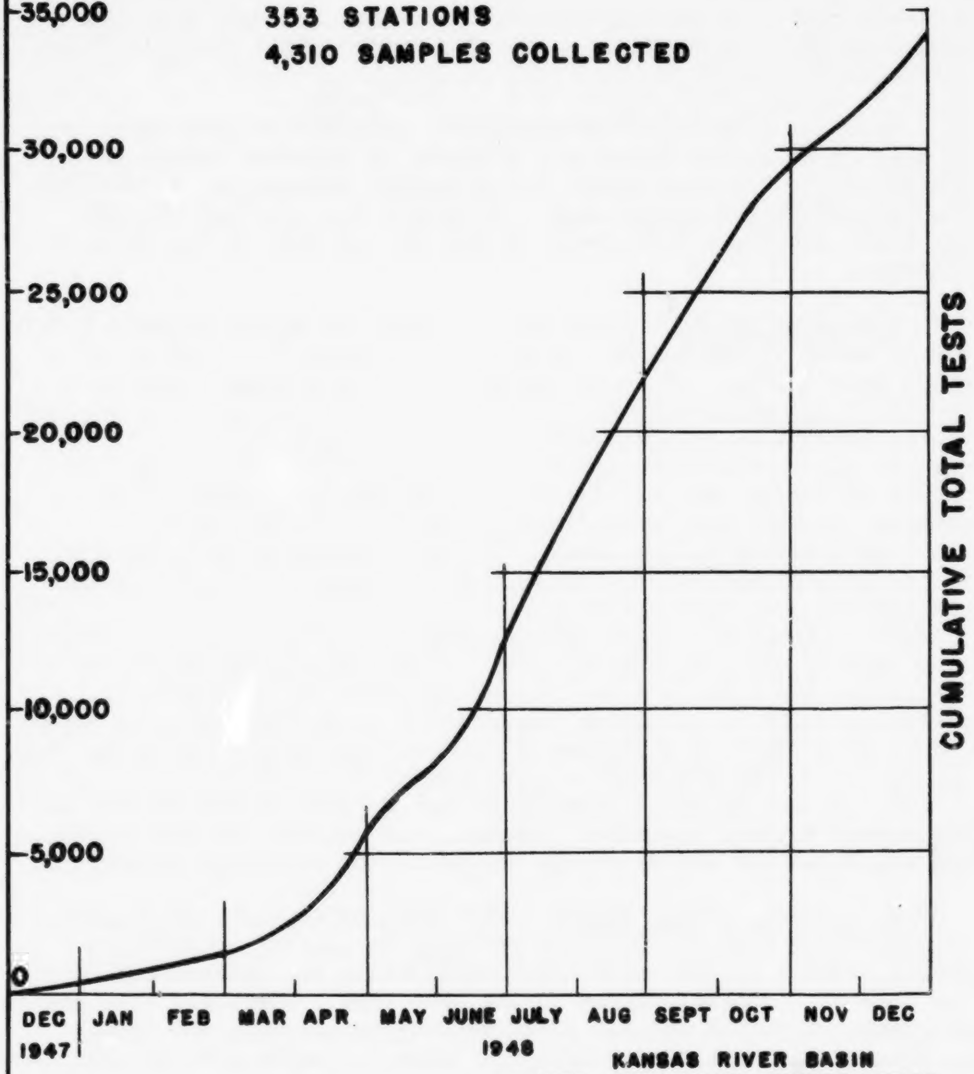
Schedule of routine laboratory operations, by months, 1947-48

Watershed	1947	1948											
	December	January	February	March	April	May	June	July	August	September	October	November	December
Arikaree River							T	T	T				S
Frenchman River (Creek)					S	S	T	T	T	S	S		S
Medicine Creek					S	S	T	T	S T	S	S		S
Sappa Creek				S	S	S	T	T	S T	S	S		S
Prairie Dog Creek				S	S	S	S T	S T	S	S	S		S T
Republican River R-218.4 to Source				S	S	S	T	T	S T	S	S		S T
Republican River R-216.8 to Mouth				L S	L S	L S	S	L S	L S	L S	L S	S T	L S T
Big Creek									S	S	S		S
Fossil Creek									S	S	S	T	S
Smoky Hill River				L	L S	L S	S	L S	L S	L S	L S	T	L S
Saline River					S	S	S	S	S	S	S	T	S
South Fork Solomon River						S	S	S	S	S	S	T	S
North Fork Solomon River					S	S	S	S	S	S	S	T	S T
Solomon River					S	S	S	S	S	S	S	T	S
Little Blue River							L	L S	L T	L T	L T	L	L S
Black Vermillion River							L	L	L	L	L		L
Blue River				L	L	L	L	L	L T	L T	L S T	L T	L S
Vermillion River				L	L	L	L	L	L	L	L	L	L
Delaware River	L	L	L	L	L	L	L	L	L	L	L	L	L
Kansas River	L	L	L	L	L	L	L	L	L	L	L	L	L
Missouri River		L	L	L	L	L	L	L	L	L	L	L	L

Symbols: L-Lawrence laboratory S-Smith Center laboratory T-Trailer laboratory

FIG. 3

CUMULATIVE NUMBERS OF TESTS MADE TO END OF EACH MONTH



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
U. S. PUBLIC HEALTH SERVICE

carried by the stream. To a limited extent a correlation exists between turbidity, B.O.D. values and high or low stream stages.

pH - pH is defined as the negative logarithm of the hydrogen ion concentration. The pH value indicates the relative acidity or alkalinity of a water, with the neutral point at pH 7.0. Values lower than 7.0 indicate the presence of acid salts, from pH 7.0 to 14.0 the presence of alkalies or alkaline earth salts.

Alkalinity - The alkalinity of a water usually indicates the presence of carbonates, bicarbonates, hydroxides, and occasionally borates, silicates and phosphates. In comparison with pH, alkalinity may be considered as a quantity factor while pH would be an intensity factor.

Chloride - The chloride content of a stream in many cases can be used as an indication of the entrance of domestic sewage or trade wastes. In this survey its principal purpose was in evaluating the effect of natural salt occurrences and possible oil and gas field wastes, particularly in the central part of the State of Kansas.

Dissolved Oxygen - Normally the amount of oxygen dissolved in stream water is limited by the saturation value (9.17 ppm at 20°C.) which is a function of water temperature, but in some cases as a result of the photosynthetic action of some water plants, including algae, this value may be exceeded, causing "supersaturation". To support fish and aquatic life and for the natural aerobic purification of stream waters, dissolved oxygen must be present, the minimum quantity permissible being dependent on the quality of water desired and stream flows. Dissolved oxygen must be present to prevent nuisance conditions associated with putrefactive decomposition of waste materials in a stream. To support fish life, considerable dissolved oxygen must be present, the required concentration varying with the fish species. Dissolved oxygen values below the saturation level are an indication of the presence of organic pollution which is utilizing oxygen from the stream water. A measure of the effect of pollution of a particular area is given by the deficiency in the dissolved oxygen content below saturation. Satisfactory methods of waste disposal to the streams depend on the relationship between character, quantity and strength of the wastes, and the character and discharge volume of the receiving stream.

Biochemical Oxygen Demand - The standard test for biochemical oxygen demand (B.O.D.) requires five-day incubation at 20°C. of sealed samples of the water under examination and determination of the loss of dissolved oxygen during that time. Where the loss may be greater than the initial dissolved oxygen present, the sample is diluted with standard B.O.D. dilution water and the measured loss multiplied by the appropriate dilution factor.

The B.O.D. thus determined becomes a measure of the amount of oxygen necessary to satisfy the biochemical oxidation requirements of the pollution present at the time the sample was collected. Since the amount of dissolved oxygen present decreases with rising temperatures and at the same time the rate of biochemical oxidation increases as the temperature rises, critical stream conditions result during the warm months particularly since these high temperatures are often combined with low stream flows.

Coliform Group Organisms - This determination gives the most accurate estimation of the degree of pollution by sewage, since it shows the approximate density of sewage type organisms that are normally found only in very small numbers in natural unpolluted streams. Coliform bacteria are normally present in the intestines of warm-blooded animals and are discharged in vast numbers in human feces, which constitute the main source of these bacteria in sewage.

Procedures

Chemical and bacteriological examinations and analyses were made in accordance with "Standard Methods for the Examination of Water and Sewage" Ninth Edition, 1946, of the American Public Health Association. Where there was any choice in equipment, supplies or procedure, or any deviation made from standard procedure, such variation was designed as an added safety factor.

SPECIAL STUDIES

Poultry Dressing Plant Studies

The plant selected for study was visited by a representative of the State Health Department and by the engineer in charge of the survey. Pertinent information was collected from the plant officials, and other plant personnel to give a comprehensive and complete production schedule of all operations. Plant records of daily production were secured. Where necessary, arrangements were made to have discharge lines cleaned and made accessible, special valves and meters installed, extra records when needed kept by plant employees and additional precautions taken to insure accurate and representative waste samples and flow data. As the operation of these plants is seasonal, it was necessary to make plans and complete a survey on short notice.

The procedure followed was to establish a flow gaging station, and if possible check flow measurements with plant meter readings before plant operation started. Survey personnel were assigned specific posts and duties, so that sampling, weir readings, reading plant meters or gages, and other duties were coordinated at fifteen minute intervals throughout the entire period of operation and the following cleanup. Individual samples were composited according to flow and stored in a convenient iced-container throughout the sampling period and return of the samples to the laboratory for analysis.

Detailed operating data covering the period of sampling were obtained from the plant. This was broken down into hourly rate, operating peak, noon hour or rest periods and total production for the entire period. Additional detailed information was secured from the proper plant source.

The laboratory analyses consisted of the following determinations: pH, settleable solids (1-hour Imhoff cone), Biochemical Oxygen Demand, suspended solids (total, fixed and volatile), turbidity, chlorides, and alkalinity (total-methyl orange).

Chloride Studies

These studies were planned and carried out during times of normal seasonal flow. In case of rains harder than an occasional shower, the work was terminated until conditions returned to the desired seasonal level.

The survey was carried on as a continuous four or five day project, starting at the mouth of the river and proceeding upstream, collecting and analyzing samples enroute. Conveniently located bridges or accessible points along the stream at regular intervals were sampled.

The mouths of all tributaries were sampled and followed toward their source if justified by a high chloride content.

Sewage Plant Studies

A number of sewage plants were sampled and laboratory analyses made. Both catch and composited samples were taken for analysis. In most cases sewage samples were collected by representatives of the State Health Department and delivered to the most convenient fixed or trailer laboratory. Where extended composited samples were taken, laboratory and field personnel from the survey cooperated in the collection

The laboratory analyses included the following determinations: pH, B.O.D., settleable solids, suspended solids, alkalinity, chlorides and phenols (occasionally).

Stream Characteristics

Dissolved oxygen studies of selected stream areas were made to attempt to locate the point of minimum dissolved oxygen content and rate of stream recovery. In most cases more extensive studies were indicated than the time and available facilities permitted.

STREAM DISCHARGE DATA

In order to correlate laboratory results with the pollution reaching the rivers it is necessary to secure momentary stream discharges at the time of sampling. Early in the program arrangements were made with the District Offices of the U. S. Geological Survey at Topeka, Kansas and Lincoln, Nebraska, to develop cooperative action to secure this information. Reimbursement to the U. S. Geological Survey for the additional cost necessitated by the extra effort required by this survey was underwritten by the Corps of Engineers and the Bureau of Reclamation. The complete list of sampling stations and weekly itinerary of sample collectors were forwarded to the Geological Survey who then correlated the activities of their men with the sampling routes. In many instances, streams having no gaging stations were rated for this survey by the U. S. Geological Survey. Many of the sampling stations were jointly checked in the field by men of the U. S. Geological Survey and of this survey to assure that both were gaging the same station. Sawed V-notches or red arrows painted on bridge handrails were used as reference points.

Sample collectors were instructed by representatives of the U. S. Geological Survey on methods of reading gages and staging streams. Then, as each sample was collected, U. S. Geological Survey gages were read, wire weight reading made, or stream heights determined with a weighted tape provided for this purpose by measuring the height from the water surface to a marked point on a bridge. Readings were made to the nearest one-hundredth of a foot and recorded on the data sheets.

Records of sampling with the gage reading or stage height, time and date of sampling, sampling point location, and river mile index were submitted periodically to the U. S. Geological Survey for flow determination. At the request of the U. S. Geological Survey temperature readings were also submitted for their information and use.

PRESENTATION OF DATA

Public Water Supplies and Sources of Pollution

Summary data by sub-basins on public water supplies (Fig. 4) and sources of organic pollution (Fig. 5) are presented in Table 5. Detailed information will be found in the sub-basin sections of this report.

Industrial Wastes - The population equivalent of organic industrial wastes is included in the sewered population equivalent of the city at or near which the industry is located. Table 6 indicates the type and sub-basin location of the various industries surveyed during this investigation.

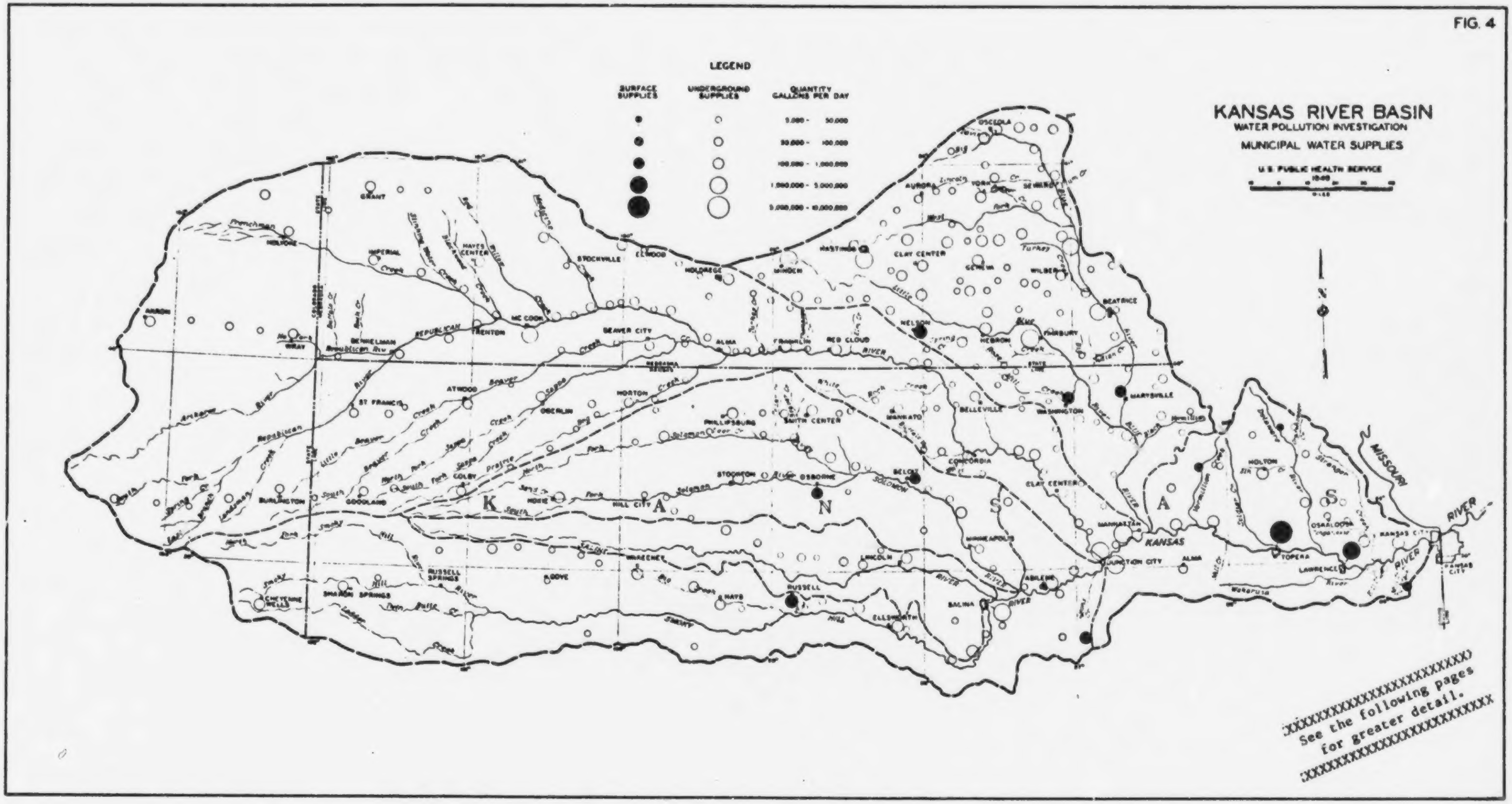
One of the most important single industrial waste in the Kansas River Basin is waste brine from the extensive oil fields located in Kansas. This waste is inorganic in nature and consequently cannot be expressed in terms of population equivalent. In view of its great importance it was considered advisable to investigate its effects in detail and to comment at some length on the general problem. Detailed studies involving the brine problem are presented in Appendixes "C" and "D". A general discussion of this problem follows.

Oil Field Brine - Incidental to the production of oil, there are lifted to the surface quantities of brine or salt water varying from insignificant amounts to over 95 per cent of the well production.

Chlorides of brines may run as high as 125,000 ppm and total solids 248,000 ppm. Improper disposal of these brines has contaminated both ground and surface waters.

Early brine disposal methods usually consisted of the uncontrolled discharge of the liquid. Later, the brine or salt water pond was developed in an attempt to prevent the mineralized waters from reaching water courses. This method, however, permitted the pollution to continue by leaks through the embankment, downward infiltration to the water table and accidental or inadvertant spills. Lining the ponds with concrete or other impervious materials to prevent loss by seepage, etc. has proved partially successful in some instances. Solar evaporation has been uniformly unsuccessful. The only entirely satisfactory means developed for the control of salt water is the sub-surface brine disposal method. It consists of returning the brine, after treatment if necessary, to suitable underground formations through a properly constructed disposal well. This method was developed as a result of cooperative studies by oil companies, the Kansas State Board of Health and the U. S. Bureau of Mines. Kansas now has over 500 brine disposal wells many of

FIG. 4



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
MUNICIPAL WATER SUPPLIES
U.S. PUBLIC HEALTH SERVICE
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See the following pages
for greater detail.
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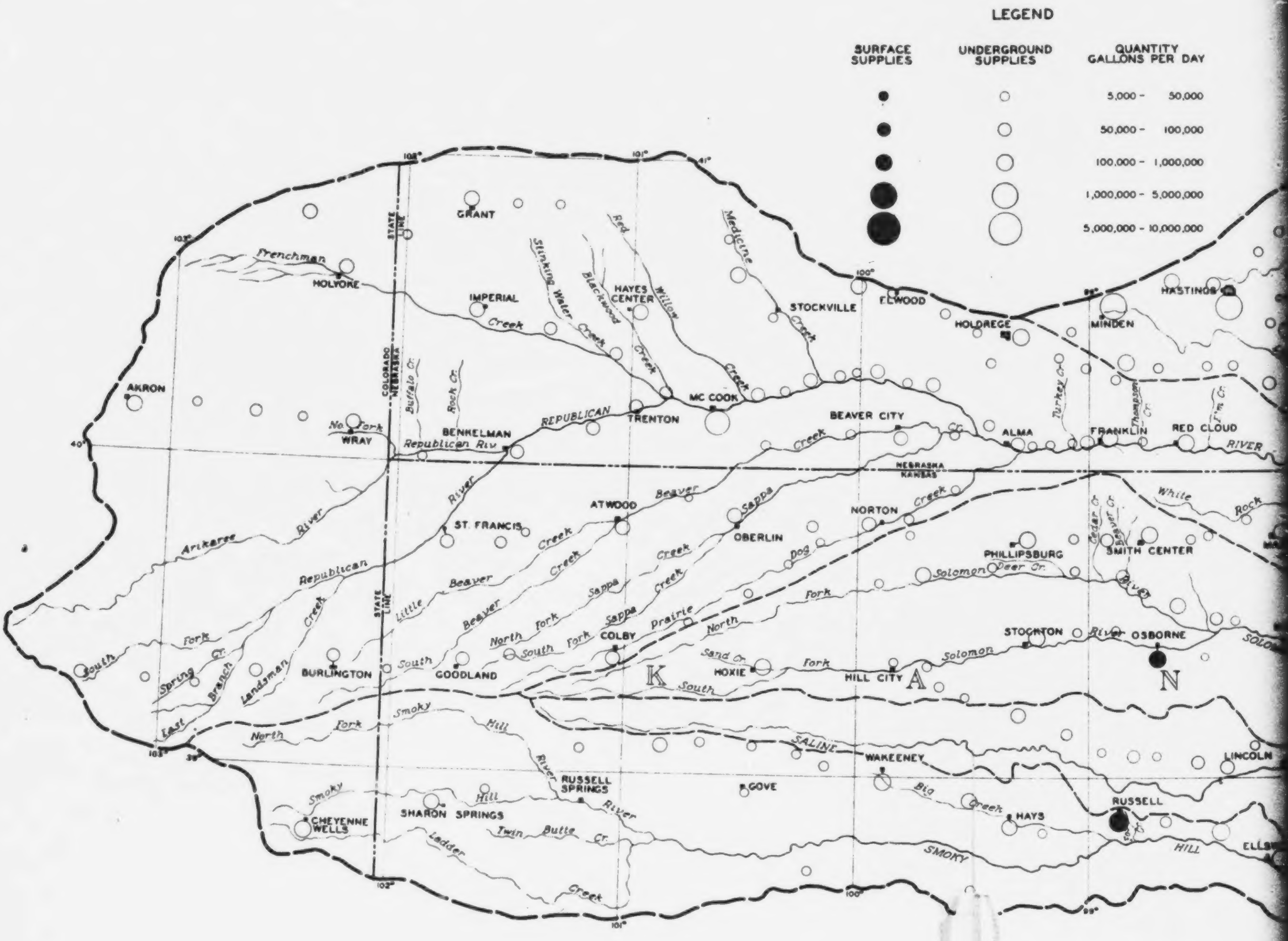
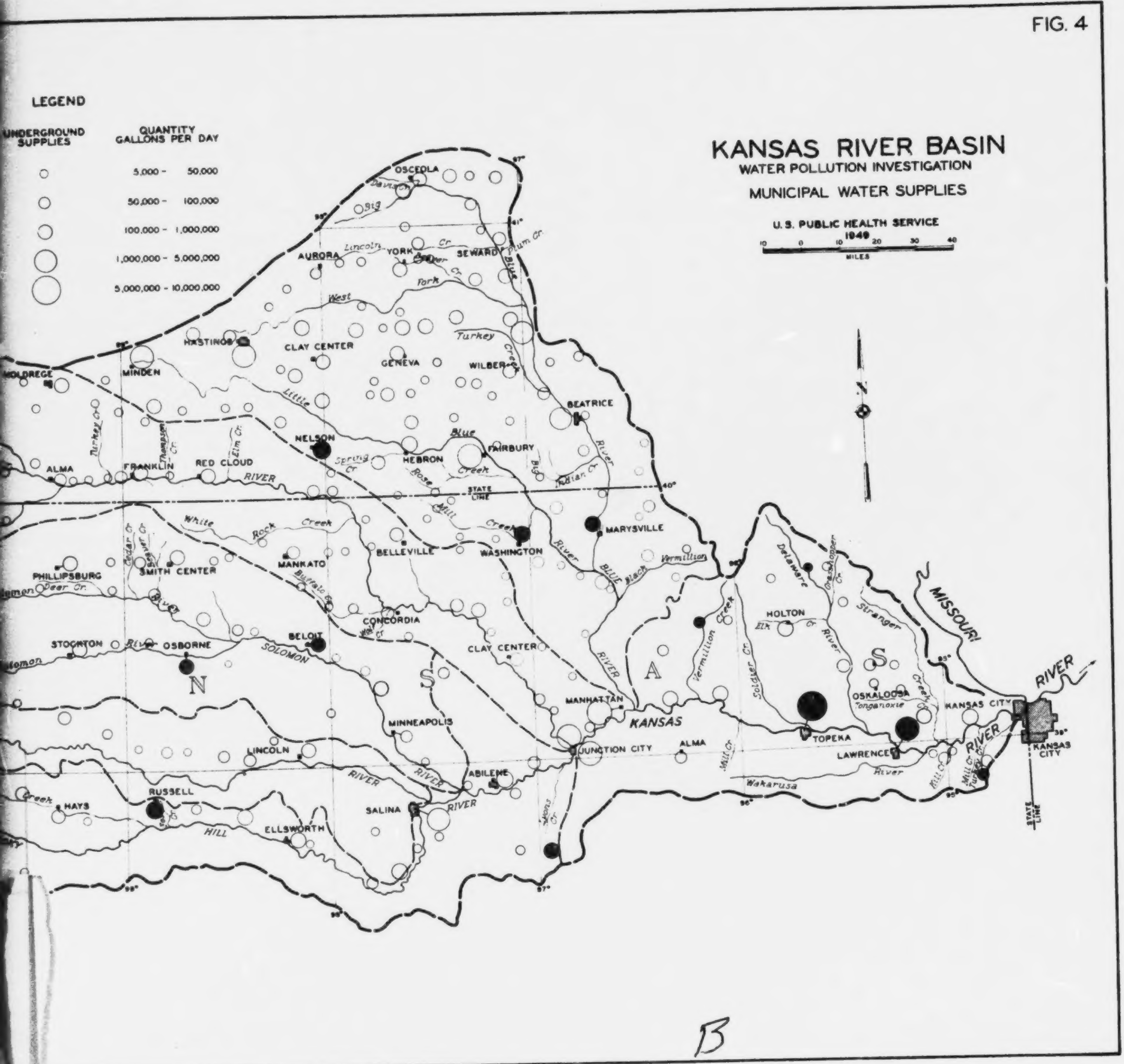

LEGEND
SURFACE SUPPLIES
UNDERGROUND SUPPLIES
QUANTITY GALLONS PER DAY
5,000 - 50,000
50,000 - 100,000
100,000 - 1,000,000
1,000,000 - 5,000,000
5,000,000 - 10,000,000
GRANT
HOLYOKE
Frenchman
IMPERIAL
Creek
HAYES CENTER
STOCKVILLE
ELWOOD
HOLDREGE
MINDEN
HASTINGS
AKRON
WRAY
BENKELMAN
TRENTON
MC COOK
BEAVER CITY
ALMA
FRANKLIN
RED CLOUD
REPUBLICAN
Republican Riv.
RIVER
NEBRASKA
KANSAS
COLORADO
STATE LINE
ST. FRANCIS
ATWOOD
OBERLIN
NORTON
PHILLIPSBURG
SMITH CENTER
STOCKTON
OSBORNE
BURLINGTON
GOODLAND
COLBY
HOXIE
HILL CITY
K A N
WAKEENEY
GOVE
RUSSELL SPRINGS
HAYS
RUSSELL
LINCOLN
CHEYENNE WELLS
SHARON SPRINGS
Arikaree River
Landsman Creek
Spring Cr.
Little Beaver
Sappa Creek
Prairie Dog Creek
North Fork Solomon
South Fork Solomon
Saline
Smoky Hill River
Big Creek
Twin Butte Cr.
Ladder Creek
Stinking Water Creek
Blackwood Creek
Red Willow Creek
Medicine Creek
Buffalo Cr.
Rock Cr.
Turkey Cr.
Thompson Cr.
White Rock
Deer Cr.
Sand Cr.
Cedar Cr.
Beaver Cr.
103°
102°
101°
100°
99°
41°
40°
39°

A

FIG. 4


KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
MUNICIPAL WATER SUPPLIES
U. S. PUBLIC HEALTH SERVICE
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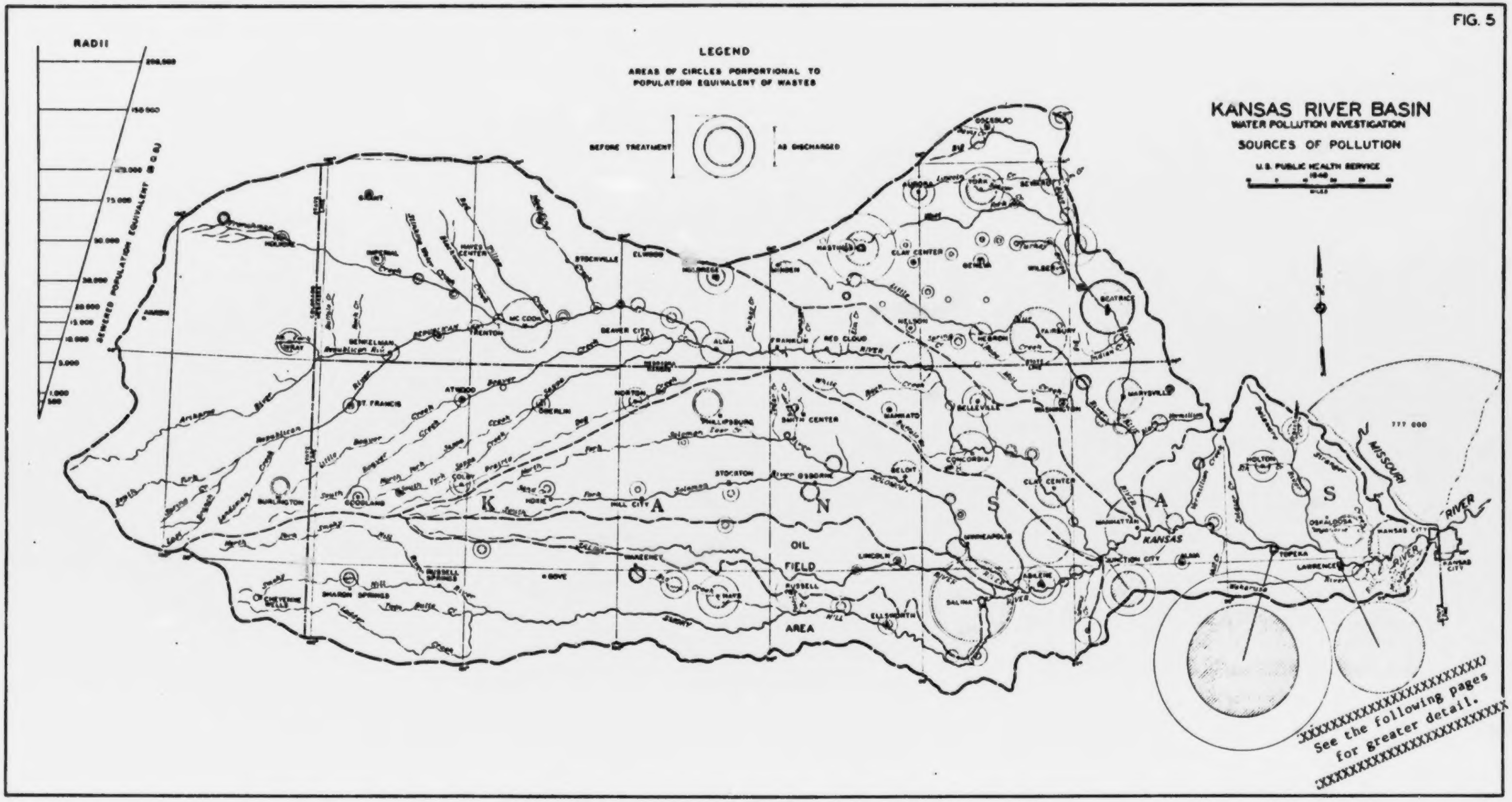
B

FIG. 5



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
SOURCES OF POLLUTION
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1946

See the following pages
for greater detail.

45-8

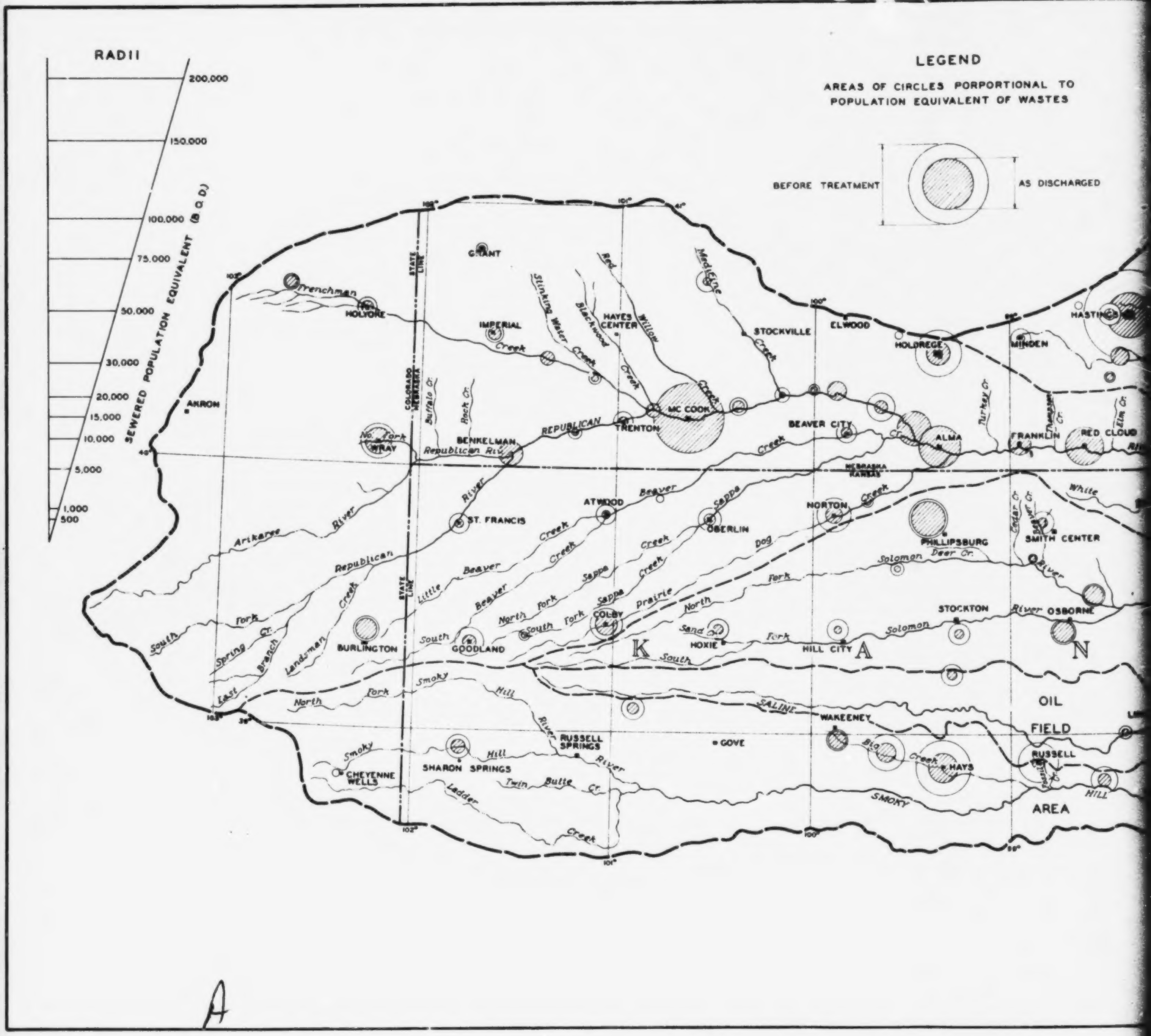
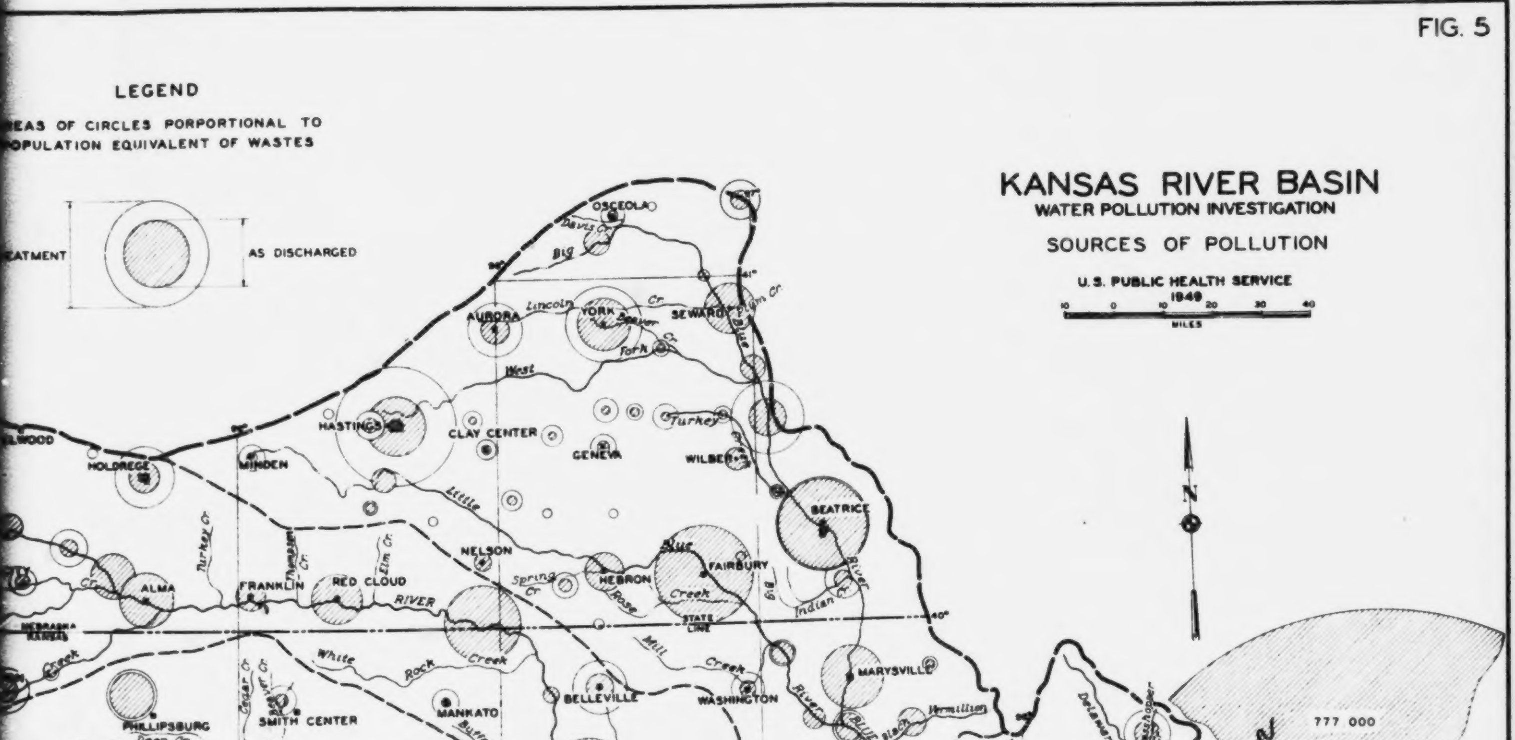

RADII
200,000
150,000
100,000
75,000
50,000
30,000
20,000
15,000
10,000
5,000
1,000
500
SEWERED POPULATION EQUIVALENT (B.O.D.)
LEGEND
AREAS OF CIRCLES PORPORTIONAL TO
POPULATION EQUIVALENT OF WASTES
BEFORE TREATMENT
AS DISCHARGED
GRANT
Frenchman
HOLYOKE
IMPERIAL
HAYES CENTER
STOCKVILLE
ELWOOD
HOLDREGE
MINDEN
HASTINGS
AKRON
WRAY
BENKELMAN
TRENTON
MC COOK
BEAVER CITY
ALMA
FRANKLIN
RED CLOUD
ATWOOD
OBERLIN
NORTON
PHILLIPSBURG
SMITH CENTER
ST. FRANCIS
BURLINGTON
GOODLAND
COLBY
HOXIE
HILL CITY
STOCKTON
OSBORNE
WAKEENEY
HAYS
RUSSELL
RUSSELL SPRINGS
GOVE
SHARON SPRINGS
CHEYENNE WELLS
Republican River
Arikaree River
Beaver Creek
Sappa Creek
Prairie Dog Creek
Solomon River
Saline
Smoky Hill River
Big Creek
Ladder Creek
Twin Butte Cr.
Medicine Creek
Red Willow Creek
Stinking Water Creek
Blackwood Creek
STATE LINE
COLORADO NEBRASKA
NEBRASKA KANSAS
K A N
OIL FIELD AREA
A

FIG. 5



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
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Table 5

Kansas River Basin

Summary Table - Water Supplies and Sources of Pollution

River Sub-basin	Municipal Water Supplies				Sources of Pollution						
	Surface		Ground		Domestic		Industrial				
	No.	Population Served	No.	Population Served	No. of Cities	Sewered Population	No. of Industries	Population Equivalent (B.O.D.)	Total Population Equivalent	Discharged Population Equivalent	% Removal by Treatment
Main Stem Kansas	5	113,400	23	56,186	19*	258,580*	87*	787,540*	1,057,360*	939,215*	10.2*
Big Blue	3	6,350	93	104,345	47	86,940	33	40,235	127,175	73,975	41.7
Republican	0	0	101	110,843	46	79,250	33	40,885	120,135	90,720	24.2
Smoky Hill	2	9,500	33	56,303	17	57,345	26	72,190	129,535	92,469	28.6
Solomon	2	6,060	31	20,262	13	16,660	10	5,405	22,065	16,385	25.7
Saline	0	0	10	5,865	3	3,030	2	290	3,320	830	75.0
Entire Kansas River Basin	12	135,310	291	353,804	145	501,805*	191*	946,545*	1,459,590*	1,213,644*	16.8*

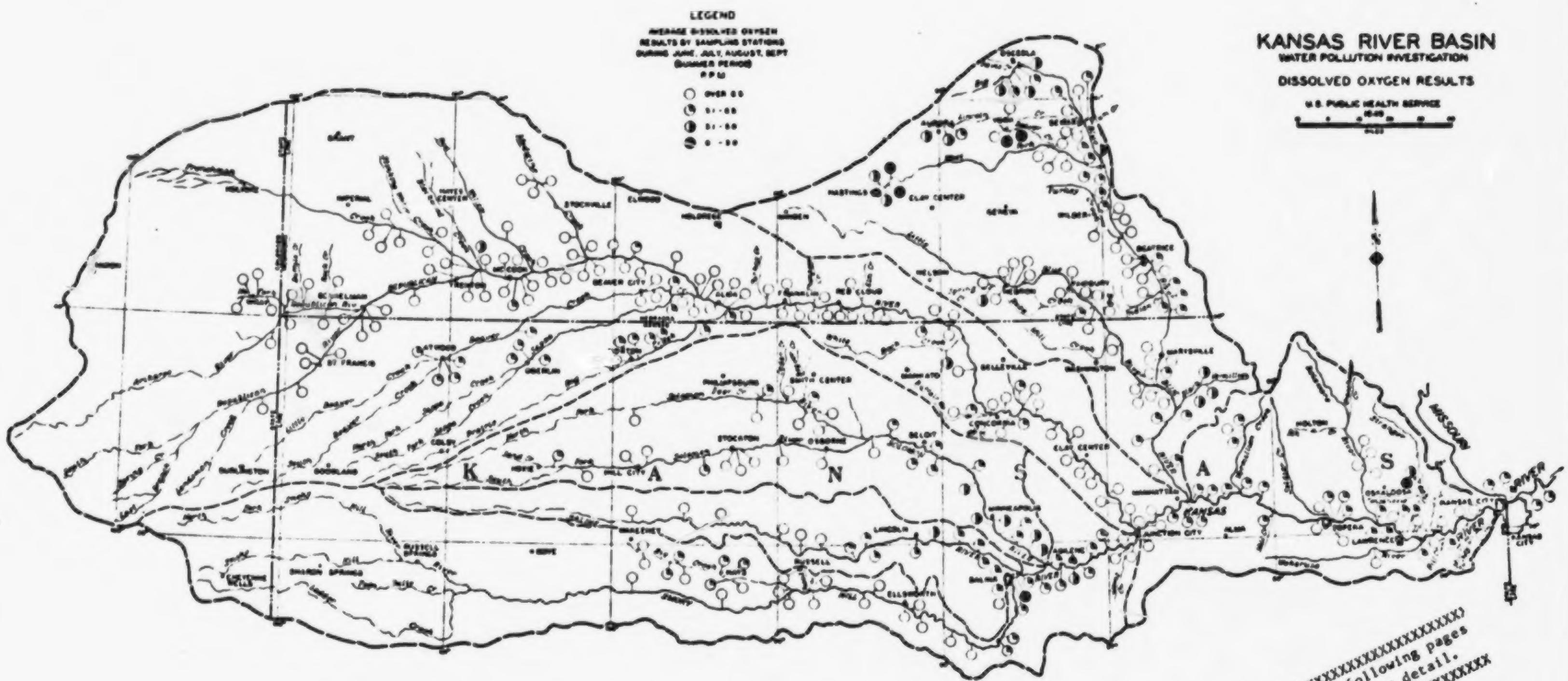
* Including Kansas City, Kansas

Table 6 **Kansas River Basin**

Industrial Establishments Surveyed by Type and Basin

Industry	Main Kansas	Big Blue	Republican	Smoky Hill	Solomon	Saline	Total
Milk	31	13	38	21	15	3	121
Slaughter House	30	14	16	14	5	2	81
Poultry Packing	22	9	9	6	1	-	47
Rendering	2	1	2	1	-	-	6
Stockyard	-	2	2	-	1	-	5
Hog Cholera Serum	4	-	-	-	-	-	4
Refinery	2	-	-	-	1	-	3
Soap Plant	2	-	-	1	-	-	3
Cannery	2	-	-	-	-	-	2
Metal Works	-	2	-	-	-	-	2
Paper Mill	1	-	-	-	-	-	1
Milling	-	-	1	-	-	-	1
Rubber Plant	1	-	-	-	-	-	1
Total	97	41	68	43	23	5	277

FIG. 6



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for greater detail.
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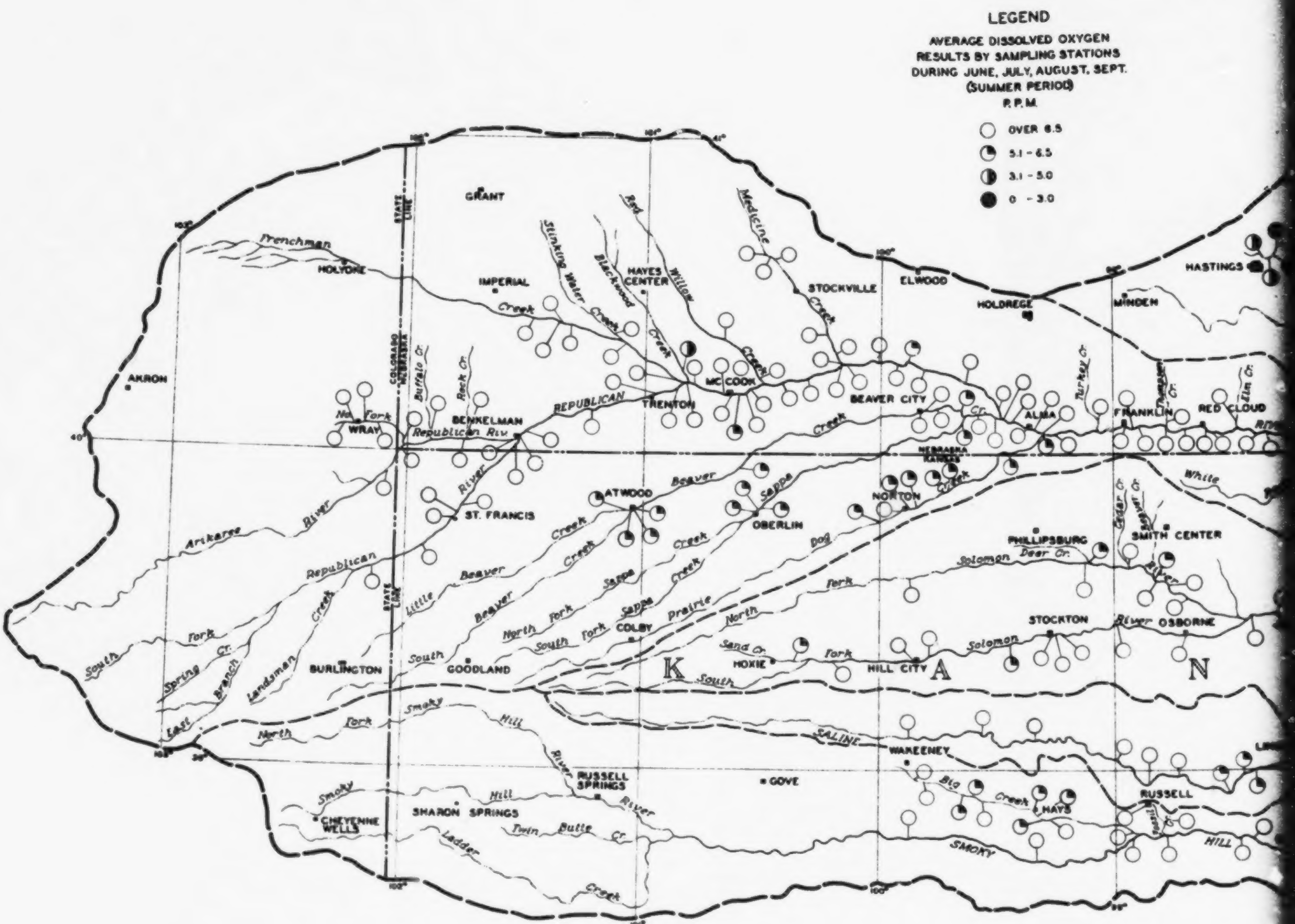
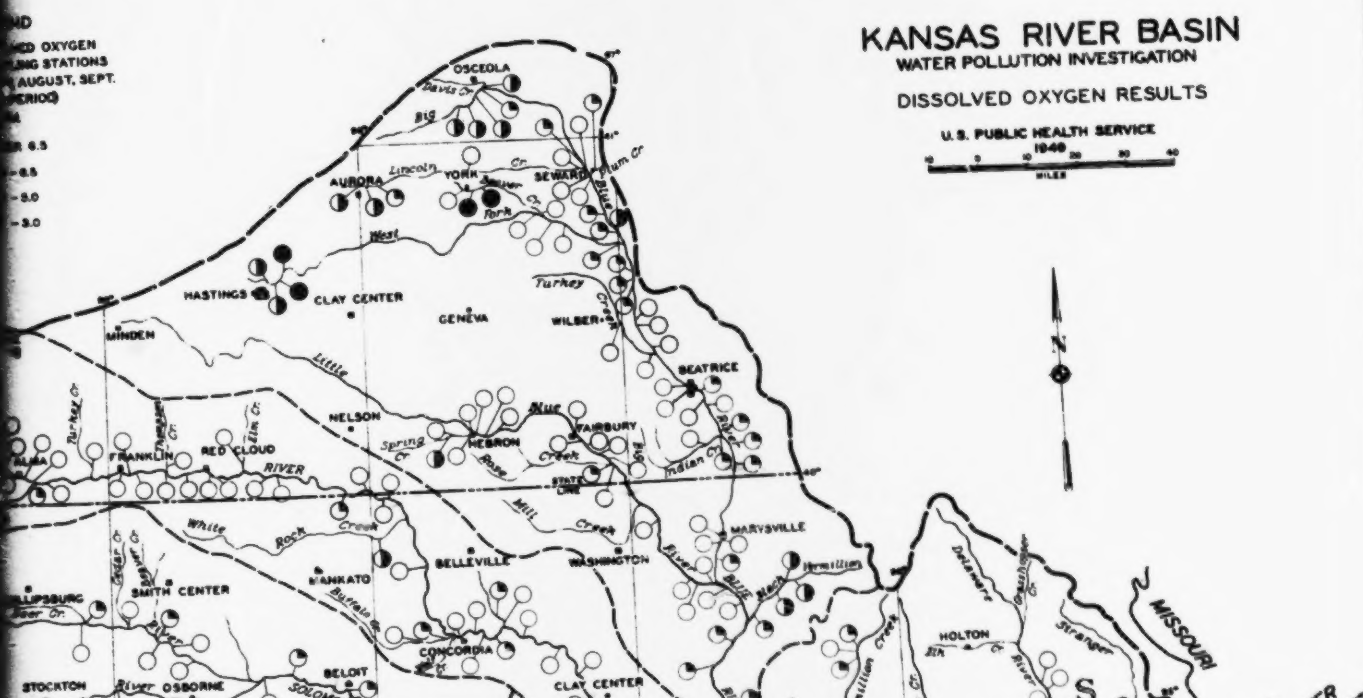

LEGEND
AVERAGE DISSOLVED OXYGEN
RESULTS BY SAMPLING STATIONS
DURING JUNE, JULY, AUGUST, SEPT.
(SUMMER PERIOD)
P.P.M.
○ OVER 6.5
◔ 5.1 - 6.5
◑ 3.1 - 5.0
● 0 - 3.0
GRANT
HOLYOKE
Frenchman
IMPERIAL
HAYES CENTER
Stinking Water Creek
Blackwood Creek
Red Willow Creek
Medicine Creek
STOCKVILLE
ELWOOD
HOLDREGE
MINDEN
HASTINGS
AKRON
WRAY
No. Fork
Buffalo Cr.
Rock Cr.
BENKELMAN
Republican Riv.
STATE LINE
COLORADO NEBRASKA
REPUBLICAN
TRENTON
MC COOK
BEAVER CITY
ALMA
Turkey Cr.
Thompson Cr.
Elm Cr.
FRANKLIN
RED CLOUD
NEBRASKA KANSAS
ST. FRANCIS
ATWOOD
Beaver Creek
Sappa Creek
OBERLIN
NORTON
Prairie Dog Creek
PHILLIPSBURG
SMITH CENTER
Cedar Cr.
White
Arikaree River
Republican
Little Beaver
North Fork
South Fork
Sappa
COLBY
Deer Cr.
Solomon River
STOCKTON
OSBORNE
Sand Cr.
HOXIE
HILL CITY
South Fork
BURLINGTON
GOODLAND
Spring Cr.
East Branch
Landsman Creek
South Fork
K A N
North Fork Smoky Hill River
SALINE
WAKEENEY
Big Creek
HAYS
RUSSELL
RUSSELL SPRINGS
GOVE
CHEYENNE WELLS
SHARON SPRINGS
Smoky Hill River
Twin Butte Cr.
Ladder Creek
SMOKY HILL
40°
100°
102°
101°
99°
98°
39°

A

FIG. 6



KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION

DISSOLVED OXYGEN RESULTS

U. S. PUBLIC HEALTH SERVICE

1946

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47-a

which are in the Kansas basin. Their total cost was in excess of $15,000,000.

Of all the varied pollution problems in the Kansas River Basin the oil field brine problem is perhaps the most important from the standpoint of Kansas water use. Many streams in the Kansas portion of the basin are naturally highly mineralized, and if to this natural mineral load is added that from large quantities of oil field brine, the receiving waters may be rendered unfit for almost all uses. Unlike sewage pollution which however great is gradually dissipated by natural purification, mineral pollution remains in the water unchanged. Thus, a water damaged by oil field brines is permanently damaged unless sufficient relatively mineral-free water is mixed with it to reduce the concentration of the minerals. Kansas was one of the first states to recognize the seriousness of the problem and to enact legislation for the control of oil field brine and the Kansas State Board of Health has pursued an active program in this field. While some damage still occurs, especially from those oil fields discovered and developed prior to legislative authorization of the State Board of Health's program, the outlook is for continued improvement in brine disposal practices in existing fields. With a good backlog of practical experience the State Board of Health's pollution control personnel should be able to meet new brine disposal problems when they arise with the discovery of new oil producing areas.

DISCUSSION

Water Quality in the Kansas River Basin

Dissolved Oxygen - In general, survey results indicate that the summer average dissolved oxygen picture in the Kansas River Basin is quite good. The majority of the streams average in excess of 5 ppm as shown on Figure 6. Notable exceptions are tributaries of the Big Blue River in Nebraska, the Smoky Hill River just below Salina, Kansas; the lower reach of the Solomon in Kansas and Tonganoxie Creek, a small tributary of the lower main stem.

Attention is directed to the fact that the results presented in Figure 6 and in other similar figures are averages and hence do not necessarily indicate the most critical conditions encountered. Such conditions, as far as oxygen is concerned, will generally occur during summer minimum flow periods, although as explained later, some deviations from this general rule do occur. Winter survey results indicate that average dissolved oxygen levels in streams of the Kansas River Basin were high. Samples collected during periods of ice coverage did not show any appreciable reduction in oxygen levels.

Biochemical Oxygen Demand (B.O.D.) - The B.O.D. map, Figure 7, indicates a number of situations where the average summer-season B.O.D. is fairly high. B.O.D. is a measure of the organic matter in the water in terms of its oxygen consuming power. B.O.D. as such is not harmful but its effect, depletion of the streams' oxygen resourses, may be quite harmful. In general, high B.O.D. values are noted below points of heavy pollution, e.g. Hastings, Nebraska; Salina, Kansas.

Figures K-1 and K-2 indicate clearly that a very large amount of pollution is discharged into the Kansas River at Kansas City, Kansas, and remedial measures are indicated. However, high B.O.D. may be caused by other than sewage or organic industrial waste pollution. High B.O.D. may result from natural, unavoidable pollution such as that derived from surface wash or heavy plankton growths in the stream. These factors may be the cause of the high B.O.D. values noted in the lower reach of the Saline River.

Coliform Organisms - These organisms, found by the billions in sewage, are indicative of this type of pollution. However, they are also found in large numbers in surface runoff from cities and agricultural areas so the previous statement must be qualified to this extent. In general, median* summer season results are high - frequently in excess of 20,000 M.P.N.** per 100 ml - throughout much of the Kansas River Basin. This indicates a combination of the effects of sewage and surface runoff pollution. The presence of large numbers of coliform organisms has much more significance from a health standpoint short distances below sources of sewage pollution than it has on sparsely populated head water streams not subject to sewage pollution. Median coliform results are shown in Figure 8.

Surface water supply treatment plants in the basin are in general subjected to high bacterial loadings. Exceptions are those cities which have developed impoundments on tributaries not subject to sewage pollution. The Topeka and Lawrence water plants which handle "run of the river" water are subjected to the highest loadings. Both of these plants are unusually well equipped to meet the treatment requirements demanded by the high bacterial content of the Kansas River water. Both the Kansas City, Kansas and the Kansas City, Missouri water plant intakes are located on the Missouri River above the Kansas - Missouri River confluence. The Missouri River is subjected to a heavy organic and bacterial pollution load above and below its confluence with the Kansas River. Part of this is

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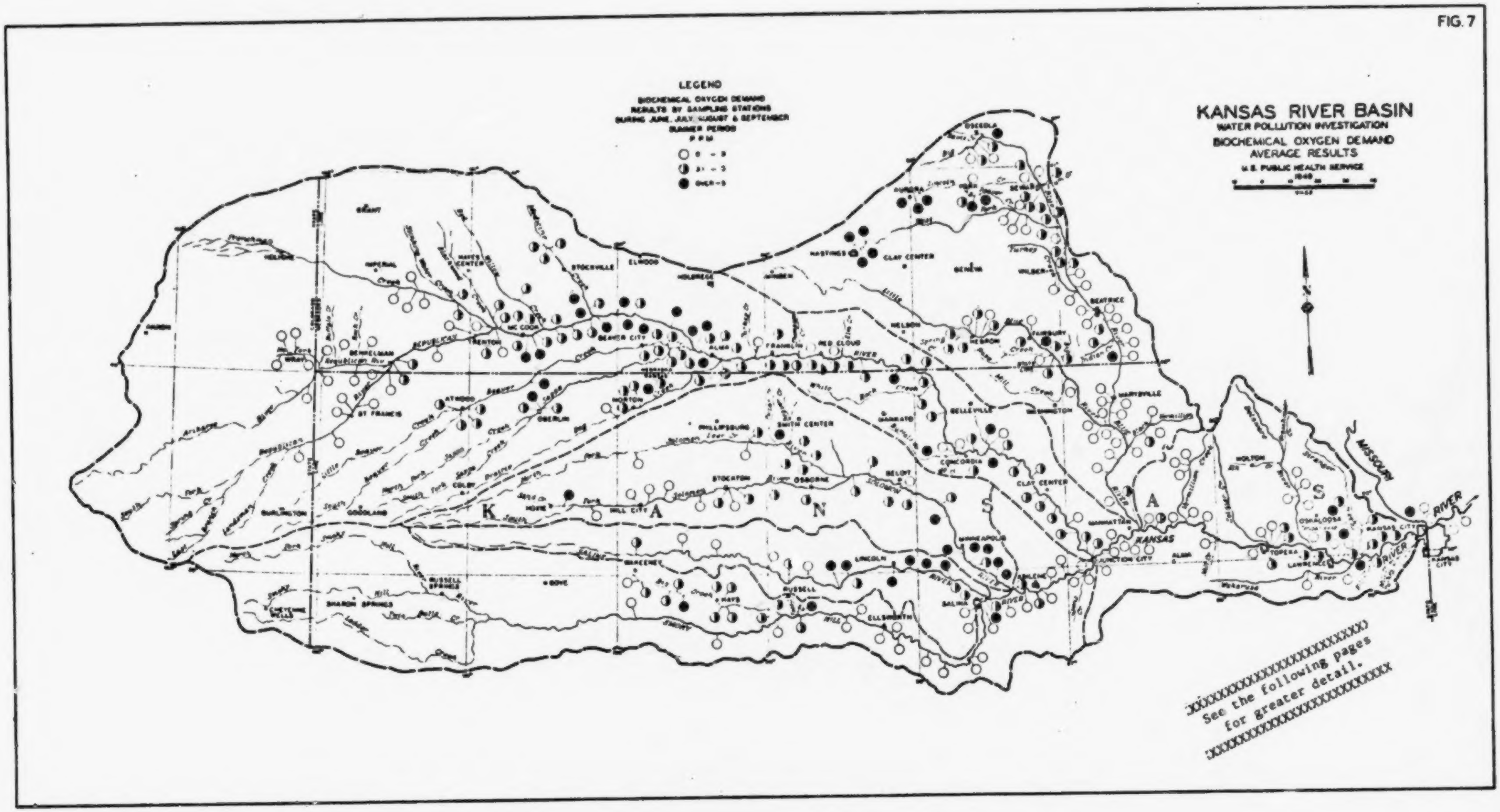
* 50 per cent of the results are higher and 50 per cent lower than the "median" value.

** Most probable number

FIG. 7



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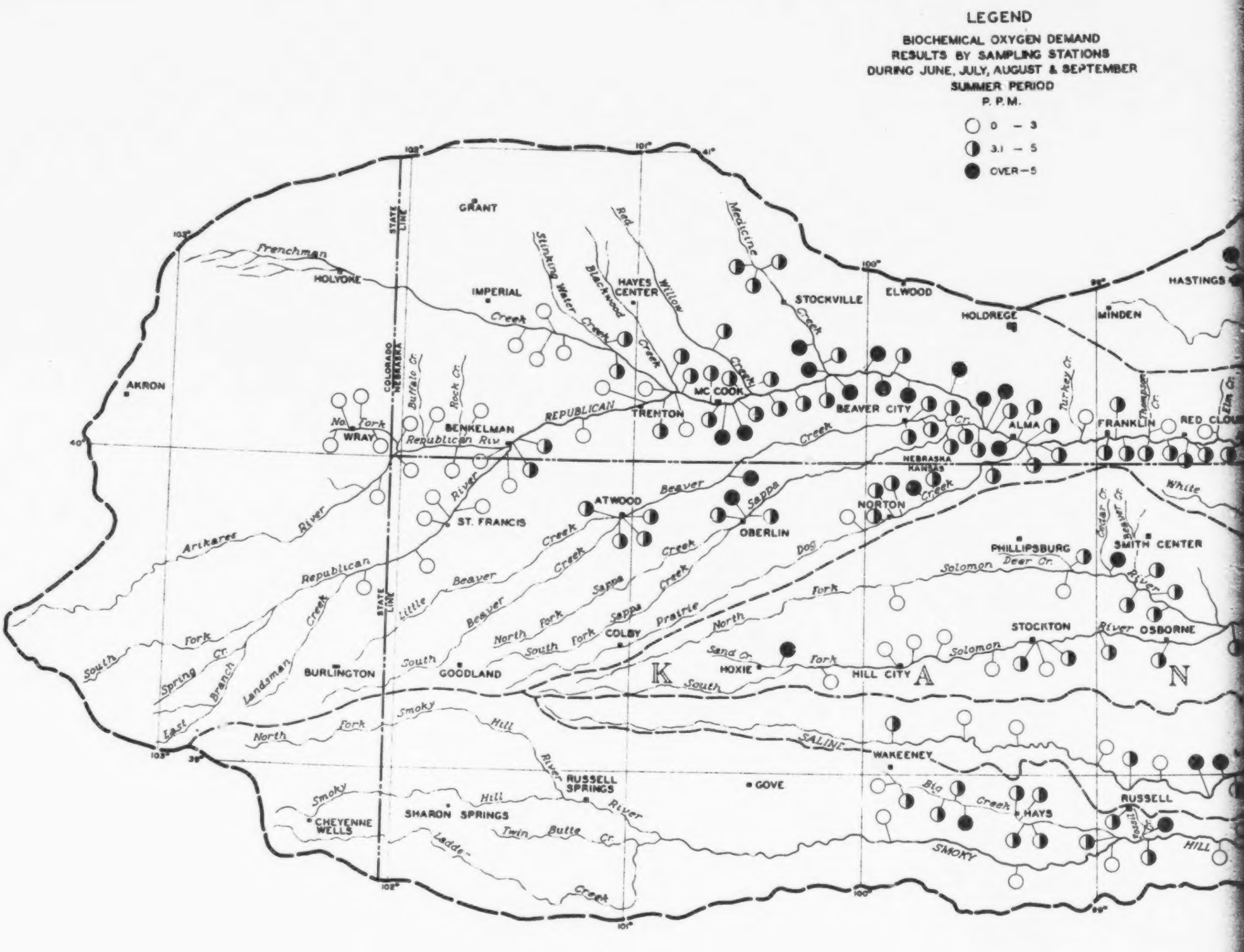
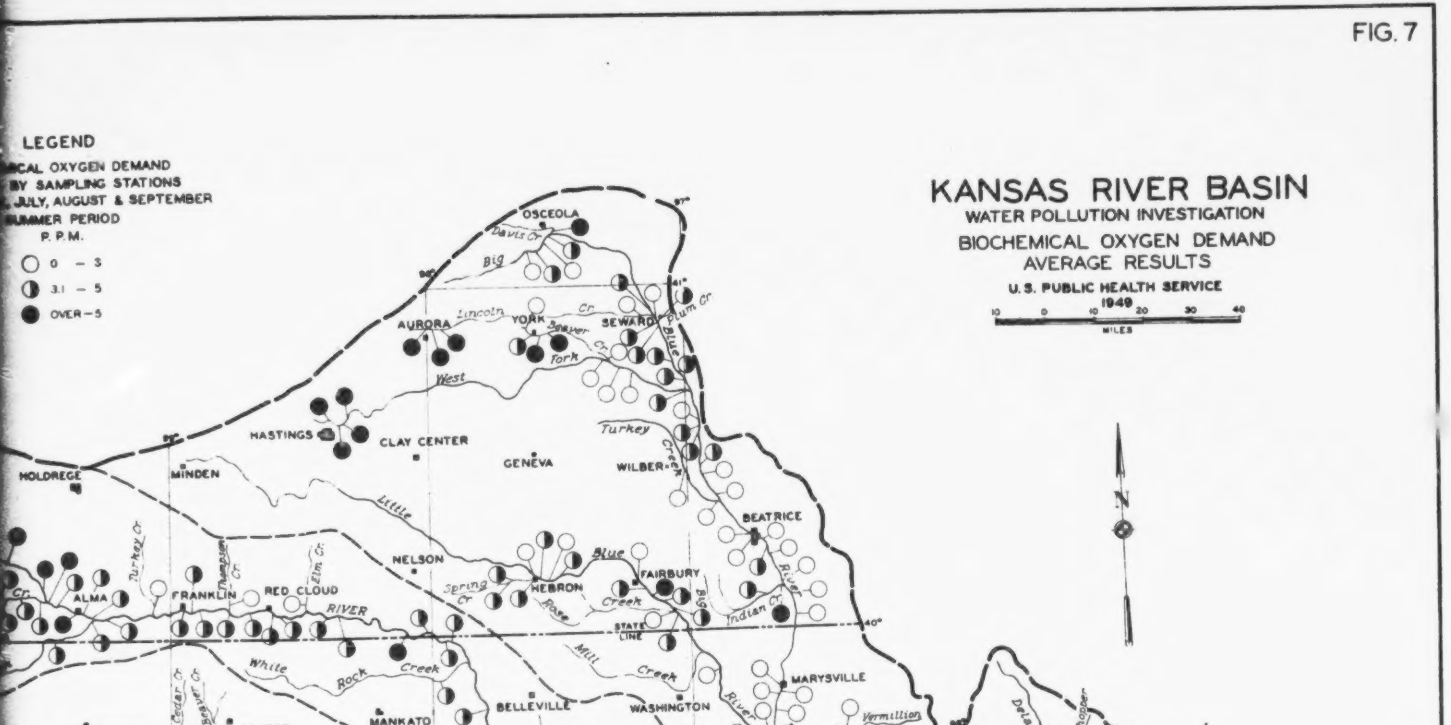

LEGEND
BIOCHEMICAL OXYGEN DEMAND
RESULTS BY SAMPLING STATIONS
DURING JUNE, JULY, AUGUST & SEPTEMBER
SUMMER PERIOD
P. P. M.
○ 0 – 3
◐ 3.1 – 5
● OVER – 5
GRANT
HOLYOKE
IMPERIAL
HAYES CENTER
STOCKVILLE
ELWOOD
HOLDREGE
MINDEN
HASTINGS
AKRON
WRAY
BENKELMAN
TRENTON
MC COOK
BEAVER CITY
ALMA
FRANKLIN
RED CLOUD
NEBRASKA
KANSAS
ST. FRANCIS
ATWOOD
OBERLIN
NORTON
PHILLIPSBURG
SMITH CENTER
STOCKTON
OSBORNE
HOXIE
HILL CITY
COLBY
GOODLAND
BURLINGTON
WAKEENEY
GOVE
RUSSELL SPRINGS
SHARON SPRINGS
CHEYENNE WELLS
HAYS
RUSSELL
K A N
COLORADO
NEBRASKA
STATE LINE
Frenchman
Stinking Water Creek
Blackwood Creek
Red Willow Creek
Medicine Creek
Buffalo Cr.
Rock Cr.
No. Fork
Republican Riv.
REPUBLICAN
Arikaree River
Republican River
South Fork
Spring Cr.
East Branch
Landsman Creek
Little Beaver Creek
Beaver Creek
Sappa Creek
North Fork Sappa Creek
South Fork Sappa Creek
Prairie Dog Creek
Turkey Cr.
Thompson Cr.
Elm Cr.
Cedar Cr.
Beaver Cr.
White
Solomon Deer Cr.
River
North Fork Solomon
Sand Cr.
South Fork Solomon River
North Fork Smoky Hill River
SALINE
Big Creek
Smoky Hill River
Twin Butte Cr.
Ladder Creek
SMOKY
HILL
103°
102°
101°
100°
99°
41°
40°
39°

A

FIG. 7



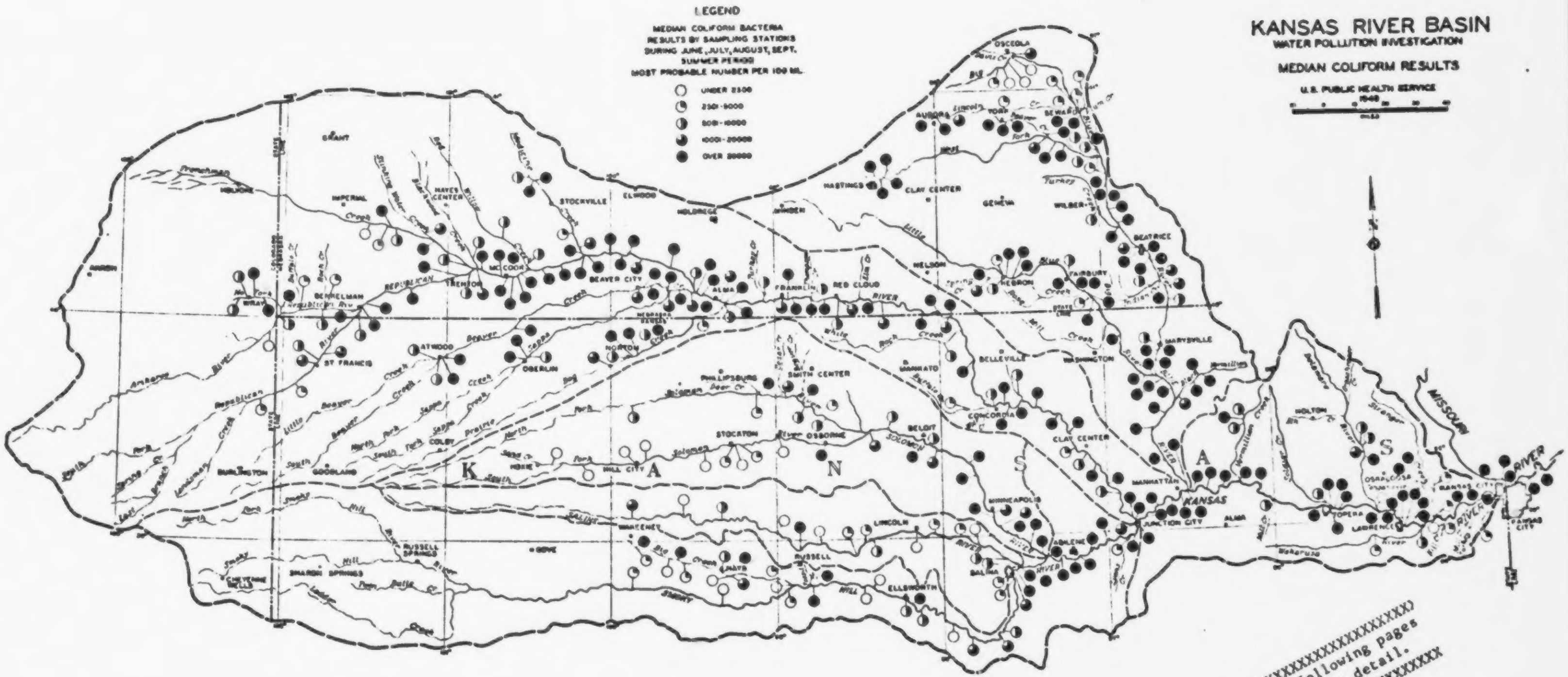
KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION

BIOCHEMICAL OXYGEN DEMAND
AVERAGE RESULTS

U.S. PUBLIC HEALTH SERVICE
1949

FIG. 8



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION

MEDIAN COLIFORM RESULTS

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See the following pages
for greater detail.
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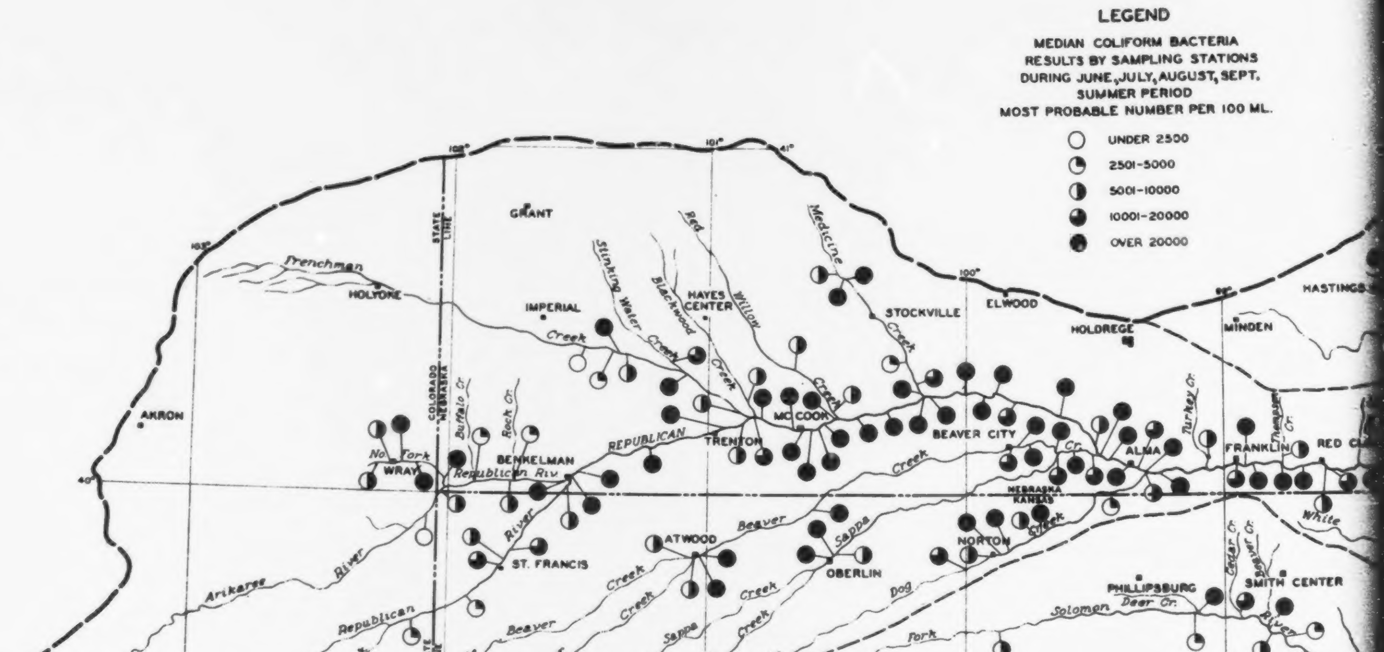
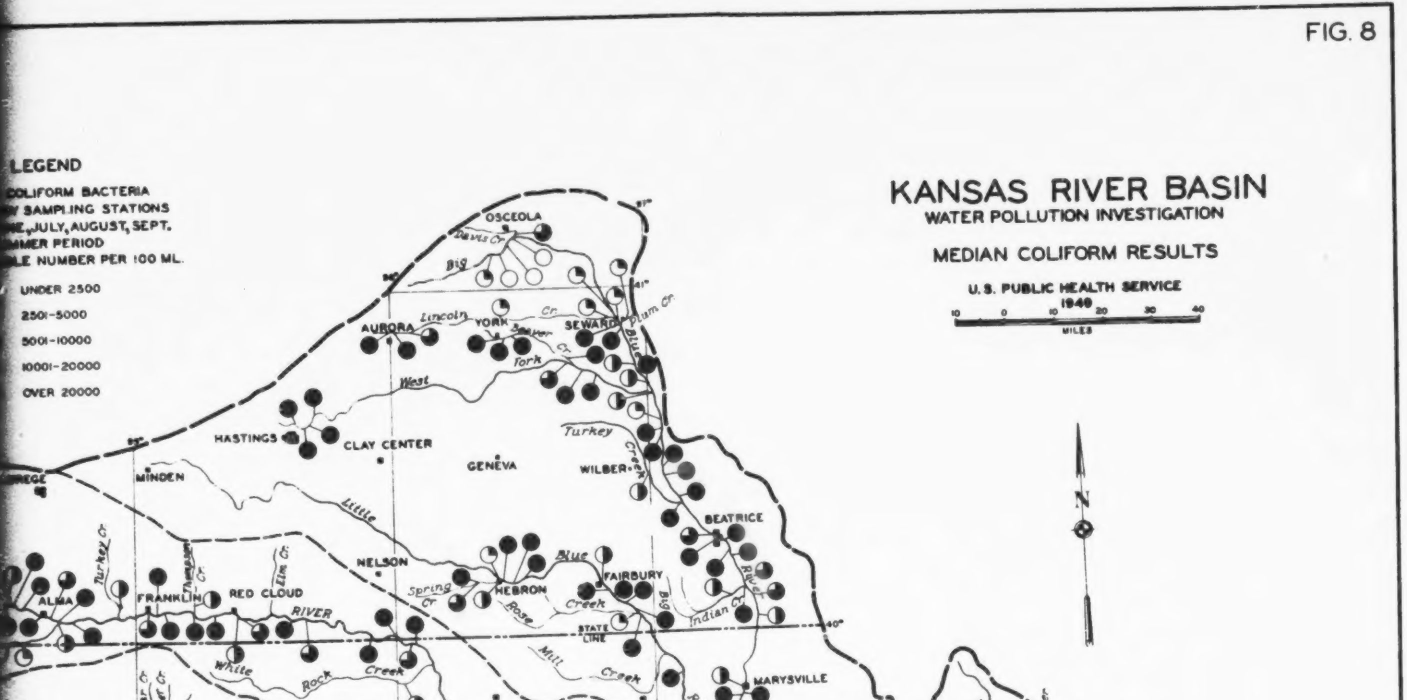
49-e


LEGEND
MEDIAN COLIFORM BACTERIA
RESULTS BY SAMPLING STATIONS
DURING JUNE, JULY, AUGUST, SEPT.
SUMMER PERIOD
MOST PROBABLE NUMBER PER 100 ML.
○ UNDER 2500
◔ 2501-5000
◑ 5001-10000
◕ 10001-20000
● OVER 20000
GRANT
IMPERIAL
HAYES CENTER
STOCKVILLE
ELWOOD
HOLDREGE
MINDEN
HASTINGS
HOLYOKE
AKRON
WRAY
BENKELMAN
TRENTON
MC COOK
BEAVER CITY
ALMA
FRANKLIN
RED CL
ATWOOD
ST. FRANCIS
OBERLIN
NORTON
NEBRASKA
KANSAS
COLORADO
NEBRASKA
STATE LINE
PHILLIPSBURG
SMITH CENTER
STOCKTON
OSBORNE
COLBY
HOXIE
HILL CITY
BURLINGTON
GOODLAND
WAKEENEY
GOVE
HAYS
RUSSELL
RUSSELL SPRINGS
SHARON SPRINGS
CHEYENNE WELLS
K A N
Frenchman
Stinking Water Creek
Blackwood Creek
Red Willow Creek
Medicine Creek
Buffalo Cr.
Rock Cr.
No. Fork
Republican Riv
REPUBLICAN
Beaver Creek
Sappa Creek
Prairie Dog Creek
Turkey Cr.
Thompson Cr.
White
Cedar Cr.
Beaver Cr.
Deer Cr.
Solomon River
North Fork
South Fork
Sand Cr.
Arikaree River
Republican River
South Fork
Spring Cr.
East Branch
Landsman Creek
Little Beaver Creek
North Fork Sappa Creek
South Fork Sappa Creek
North Fork Smoky Hill River
SALINE
Big Creek
Smoky Hill River
Twin Butte Cr.
Ladder Creek
SMOKY HILL
Fossil Cr.
102°
101°
100°
99°
103°
41°
40°
39°

A

FIG. 8


KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
MEDIAN COLIFORM RESULTS
U.S. PUBLIC HEALTH SERVICE
1949

B

49-6

derived directly from untreated Kansas City, Kansas sewage, part from the Kansas River, and part from untreated sewage from Kansas City, Missouri.

In general, coliform bacteria numbers vary approximately directly with the turbidity of the surface streams. This supports the contention that much of the bacterial load is derived from surface wash. Turbidity in turn varies nearly directly with stream stage so it may be said that, in general, high coliform bacteria numbers are associated with high flows under natural run-off conditions. The laboratory and flow data given in Appendix "H" confirm this, and this same conclusion was reached in a 1922 bacteriological survey of the Kansas River and its tributaries conducted by the Kansas State Board of Health.

Minerals - The mineral quality of the surface streams in the Kansas River Basin varies from satisfactory to poor. In general, the streams show a fairly high hardness caused by calcium and magnesium compounds derived from limestone and gypsum deposits. Some of the streams, notably the Saline, are quite high in sulfate. None of the streams contain excessive concentrations of fluoride although some ground water supplies in the Basin show high fluoride values.

Excessive chloride concentrations are one of the major water problems of the Basin. This is graphically indicated in Figures 9 and 10. Excessive chloride concentrations are found principally in the Saline, Smoky Hill, and Solomon Rivers. The Saline and the Smoky Hill are the biggest contributors. The effects of the high concentrations in these streams are noted in the main Kansas River which occasionally shows chloride concentrations in excess of the recommended limit of 250 ppm. (Public Health Service Drinking Water Standards - 1946). The high chloride concentrations are derived from natural salt deposits which underlie much of the Smoky Hill and Saline Basins and also from waste brine from the extensive oil fields in the western part of the Kansas Basin. Oil field brine is subject to control by the Kansas State Board of Health and this department has carried on an active and successful program for the prevention of brine pollution. This problem is discussed in detail in Appendixes "C" and "D" and the oil field brine summary given in this General Section. Chloride pollution from natural salt deposits cannot be controlled and will always be present in certain streams.

The possible adverse effect of a sharp flow reduction in the Main Kansas River if such condition results from diversion of Republican River water to irrigation uses must be considered. This would result in degradation of the mineral quality of the water in the main stem, and damage to the public water supplies involved. Chloride concentration increase would be the most serious effect.

Physical Characteristics - Water temperatures range from at or near the freezing point during the winter months to highs above 77°F (25°C) in the summer. Water temperatures influence many important stream sanitation factors. These are discussed briefly in the section on survey methods. In addition, water temperatures are important to city and industrial water supplies, particularly if the industry uses the water for cooling purposes.

Temperature data of general interest are presented in Table 7. Temperatures at the time of sampling are given in Appendix "H".

Turbidity varies approximately directly with stream stage and ranges from less than 10 ppm during low flow periods to maxima of over 50,000 ppm at high stream stages at Lawrence, Kansas, as reported by the Kansas State Board of Health. Turbidity responds quickly to heavy runoff, particularly in the Main Kansas Basin.

Color is not a generally serious problem in this basin. Most of the streams are relatively free of "true color"; i.e., colored substances in solution. The smoky appearance of some streams is usually due to clay in a state of colloidal suspension. Exceptions are encountered on some tributaries and in some impounded water supplies.

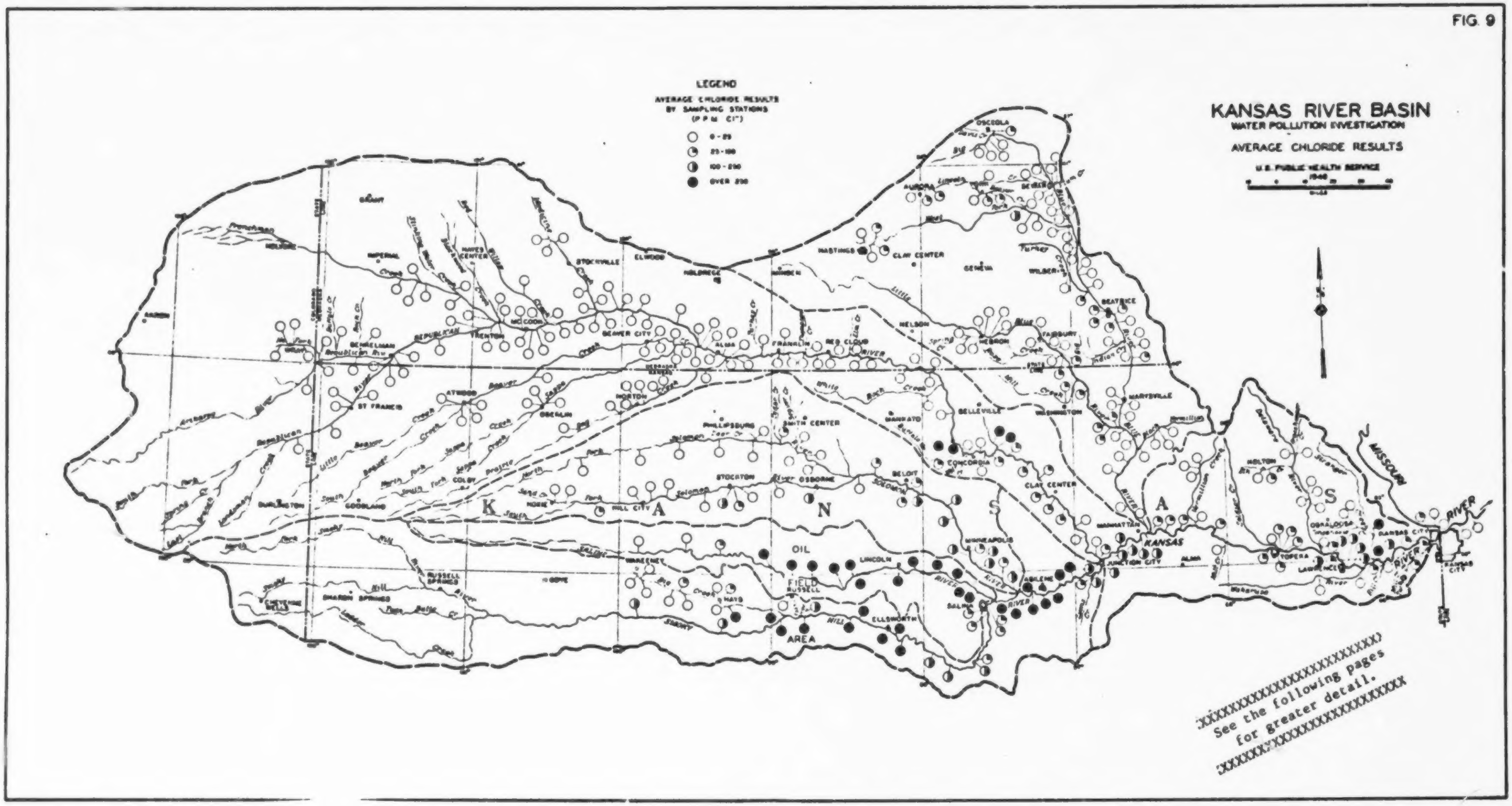
Tastes and Odors - One of the most vexing problems at some of the surface water treatment plants in the Basin is that of tastes and odors caused by the growth of microscopic organisms (algae) in streams and impounding reservoirs during the late spring, summer and early fall seasons. This type of growth is a natural phenomenon and these organisms produce tastes and odors that are often difficult and expensive to remove by water treatment. Usually they cause the greatest problem in impounded water supplies. However, serious, though infrequent, difficulties of this nature have occurred at the Lawrence water treatment plant which takes water directly from the Main Kansas River. Growths of these organisms can be controlled in reservoirs but not readily in streams.

Heavy growth of these microscopic organisms, generally termed "algae", and most of which contain chlorophyll, is favored by organic and mineral matter in solution, sunlight and clear, quiet water.

Reservoirs in the Kansas River Basin will usually supply these growth factors, as many water works operators will testify from experience.

Sometimes tastes and odors caused by these organisms are extremely difficult and expensive to remove at even the most efficient

FIG. 9



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
AVERAGE CHLORIDE RESULTS
U.S. PUBLIC HEALTH SERVICE
1946

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See the following pages
for greater detail.
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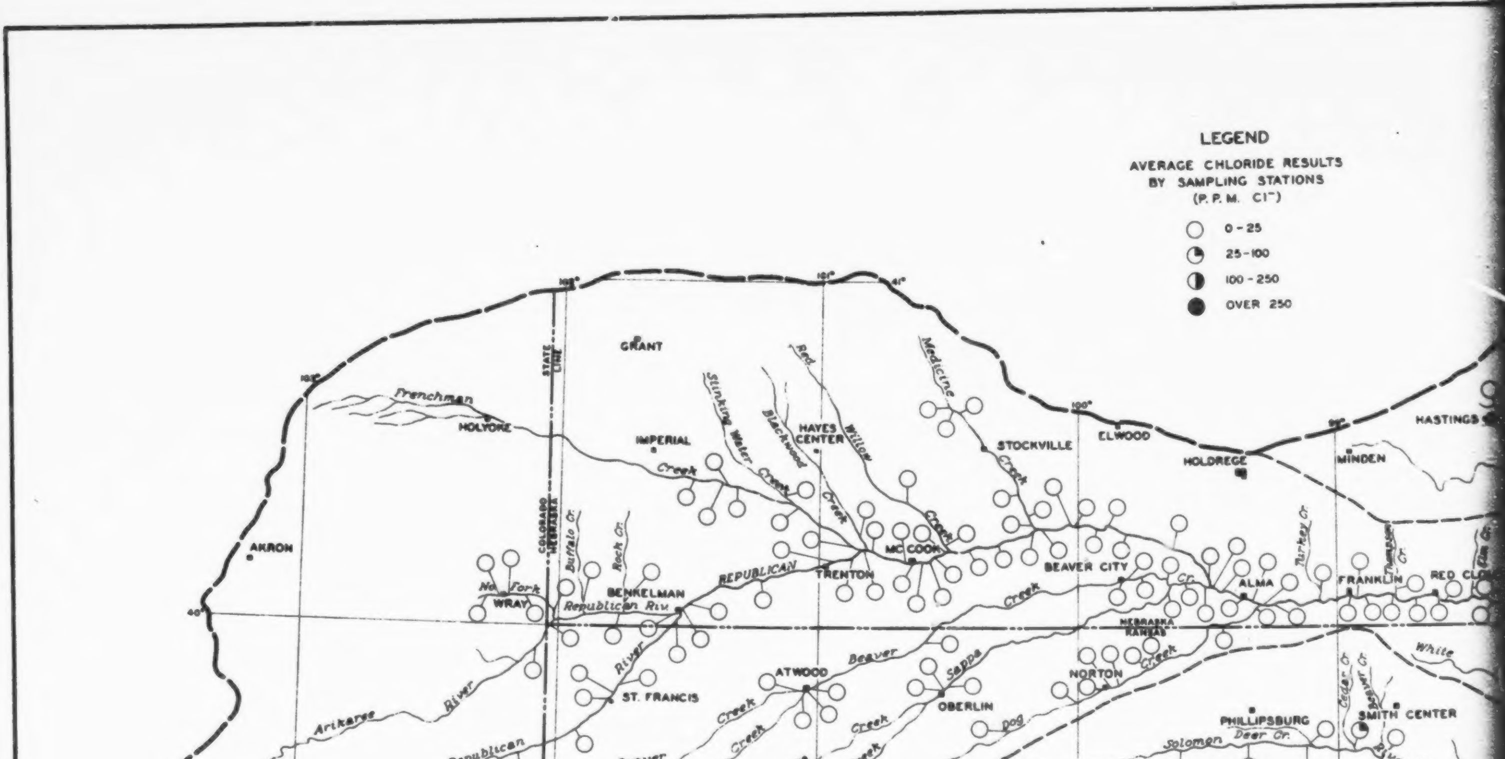
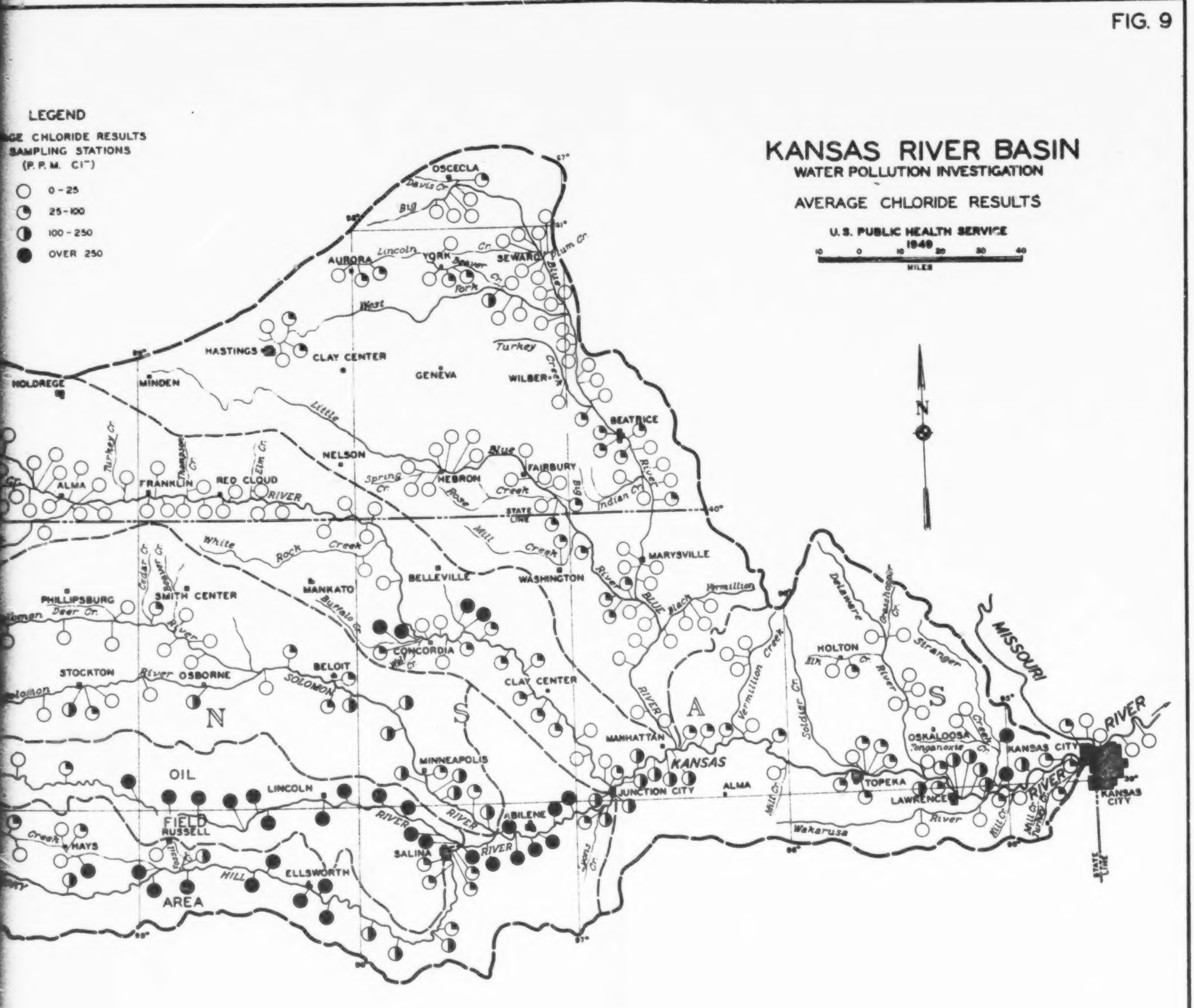
51-a


LEGEND
AVERAGE CHLORIDE RESULTS BY SAMPLING STATIONS (P.P.M. Cl⁻)
○ 0-25
◔ 25-100
◑ 100-250
● OVER 250
GRANT
HOLYOKE
IMPERIAL
HAYES CENTER
STOCKVILLE
ELWOOD
HOLDREGE
MINDEN
HASTINGS
AKRON
WRAY
BENKELMAN
TRENTON
MC COOK
BEAVER CITY
ALMA
FRANKLIN
RED CLO
NEBRASKA
KANSAS
COLORADO
NEBRASKA
STATE LINE
ST. FRANCIS
ATWOOD
OBERLIN
NORTON
PHILLIPSBURG
SMITH CENTER
STOCKTON
OSBORNE
COLBY
HOXIE
HILL CITY
BURLINGTON
GOODLAND
WAKEENEY
GOVE
RUSSELL SPRINGS
SHARON SPRINGS
CHEYENNE WELLS
HAYS
RUSSELL
OIL FIELD AREA
K A N
Frenchman
Creek
Stinking Water Creek
Blackwood Creek
Red Willow Creek
Medicine Creek
Buffalo Cr.
Rock Cr.
No. Fork
Republican Riv.
REPUBLICAN
River
Beaver Creek
Sappa Creek
Turkey Cr.
Thompson Cr.
Elm Cr.
White
Arikaree River
Republican
Little Beaver
North Fork
South Fork
Sappa
Prairie Dog Creek
Solomon
Deer Cr.
Cedar Cr.
Beaver Cr.
Oak Cr.
North Fork Solomon River
South Fork
Sand Cr.
South
Spring Cr.
East Branch
Landsman Creek
North Fork Smoky Hill River
SALINE
Big Creek
Smoky Hill River
Twin Butte Cr.
Ladder Creek
SMOKY HILL
102°
101°
100°
99°
40°
41°
39°
103°

A

FIG. 9



KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION

AVERAGE CHLORIDE RESULTS

U.S. PUBLIC HEALTH SERVICE
1949

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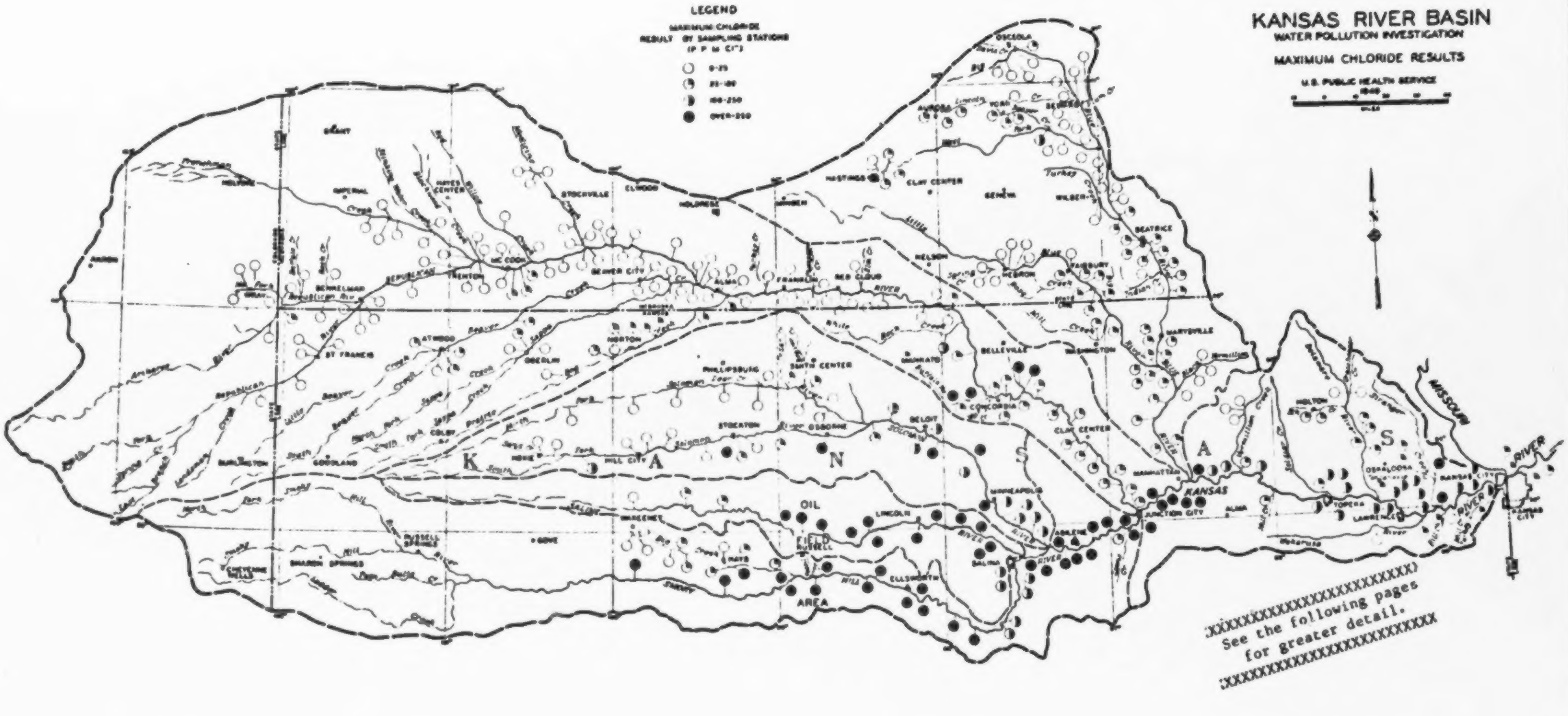
51-a

FIG 10



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for greater detail.
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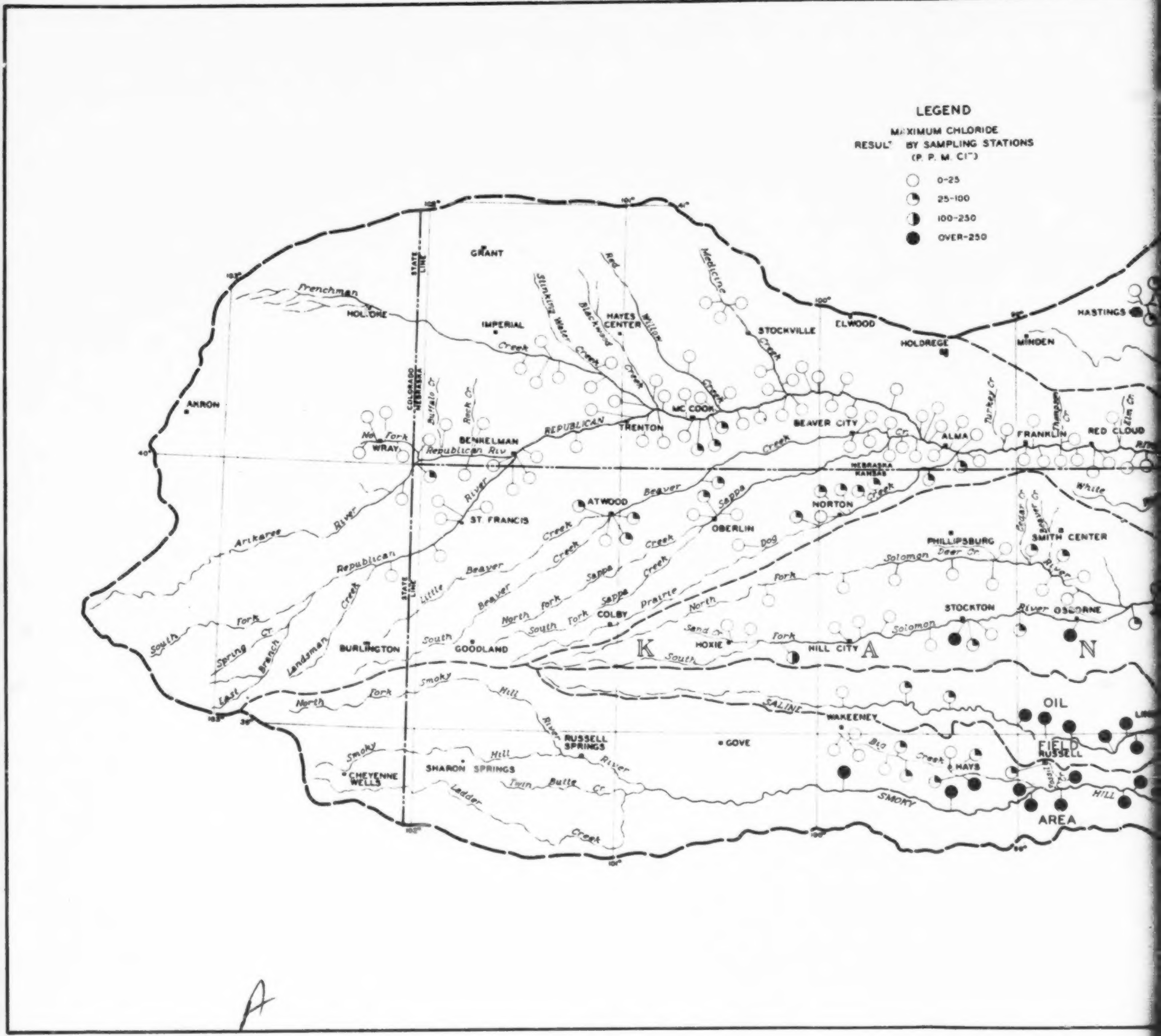
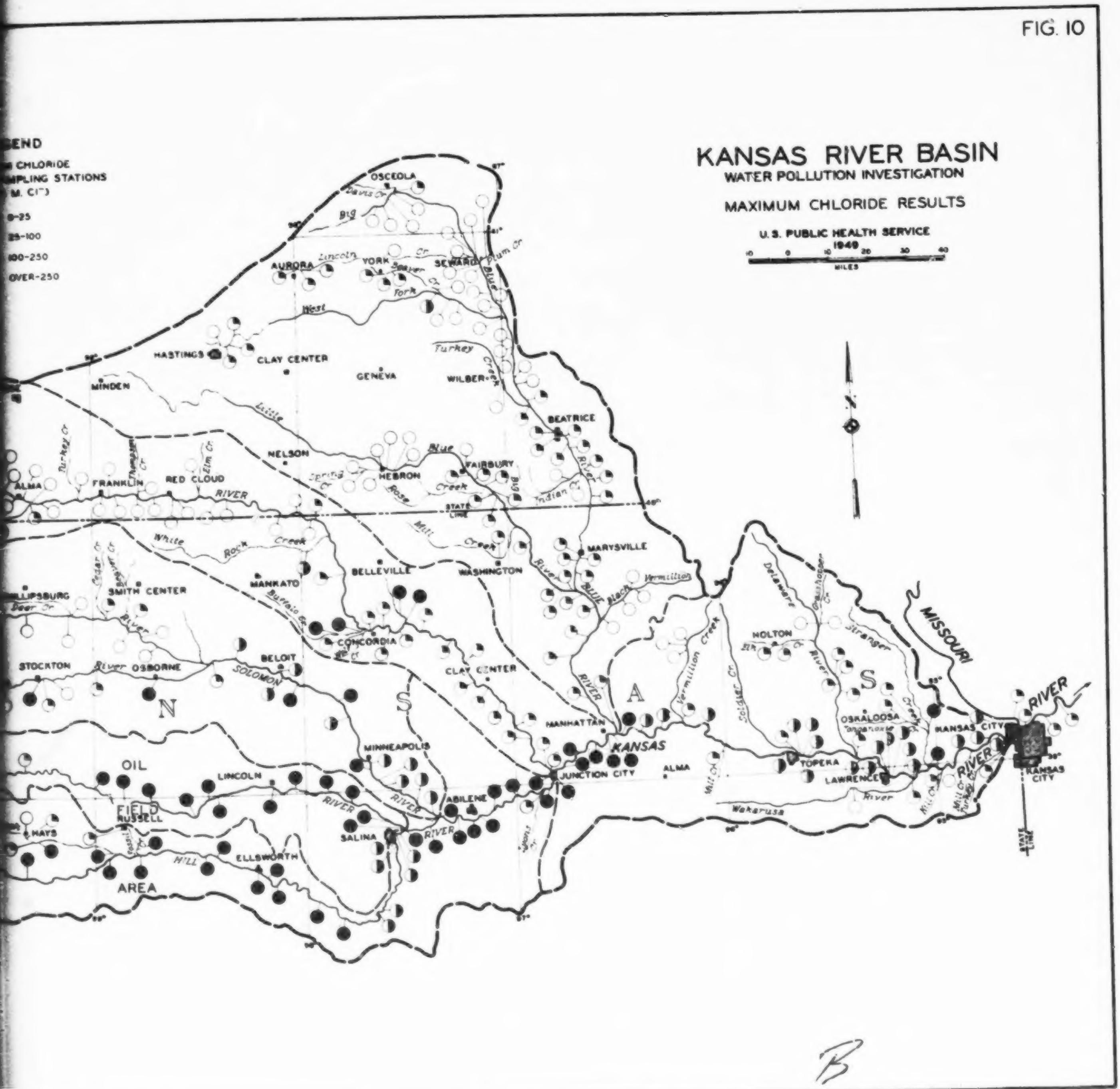
51-8


LEGEND
MAXIMUM CHLORIDE
RESULTS BY SAMPLING STATIONS
(P. P. M. Cl⁻)
○ 0-25
◔ 25-100
◑ 100-250
● OVER-250
GRANT
HOLYOKE
Frenchman
IMPERIAL
HAYES CENTER
Stinking Water Creek
Blackwood Creek
Red Willow Creek
Medicine Creek
STOCKVILLE
ELWOOD
HOLDREGE
MINDEN
HASTINGS
AKRON
WRAY
No. Fork
Republican Riv.
BENKELMAN
Buffalo Cr.
Rock Cr.
REPUBLICAN
TRENTON
MC COOK
BEAVER CITY
ALMA
Turkey Cr.
FRANKLIN
Thompson Cr.
RED CLOUD
Elm Cr.
COLORADO
NEBRASKA
NEBRASKA
KANSAS
STATE LINE
ST. FRANCIS
ATWOOD
Beaver Creek
Sappa Creek
OBERLIN
NORTON
Prairie Dog Creek
PHILLIPSBURG
SMITH CENTER
Cedar Cr.
White
Arikaree River
Republican
Little Beaver Creek
North Fork Sappa Creek
South Fork Sappa Creek
North Fork Solomon
Deer Cr.
COLBY
South Fork Republican
Spring Cr.
East Branch
Landsman Creek
BURLINGTON
GOODLAND
Sand Cr.
HOXIE
South Fork Solomon
HILL CITY
STOCKTON
Solomon River
OSBORNE
K A N
North Fork Smoky Hill River
SALINE
WAKEENEY
OIL FIELD AREA
RUSSELL
Big Creek
HAYS
GOVE
RUSSELL SPRINGS
Smoky Hill River
SHARON SPRINGS
CHEYENNE WELLS
Twin Butte Cr.
Ladder Creek
SMOKY HILL
40°
39°
102°
101°
100°
99°
103°

A

FIG. 10



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION

MAXIMUM CHLORIDE RESULTS

U. S. PUBLIC HEALTH SERVICE
1949

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Table 7

Kansas River Basin

Average Water Temperatures

Month	(1)		(2)	
	oC	oF	oC	oF
January	1	34	0.6	33
February	0	32	1.1	34
March	4	39	2.8	37
April	14	57	12.2	54.0
May	19	66	18.9	66.0
June	23	73	22.2	72.0
July	24	75	26.7	80.1
August	25	77	26.1	79.0
September	20	68	24.4	75.9
October	14	57	15.0	59.0
November	6	43	8.9	48
December	2	36	2.2	36

(1) Average of yearly sampling along Main Stem Kansas River - 1948 - Kansas River Basin Water Pollution Investigation.

(2) Kansas City, Missouri, treatment plant, Missouri River - 1948 - temperatures taken from a 24-hr. recording temperature gauge at 7:00 a.m. each day.

water treatment plants, and in addition, their presence can render the other problems of water plant operation more difficult and expensive.

In a few instances in other areas of the United States, heavy growths of a blue-green type of organism have been found to render the water containing them quite toxic and have caused the death of cattle and other animals drinking such water. As far as it is known now, however, modern water treatment methods render the water potable for human consumption even though the water treatment processes may not remove all of the taste and odor caused by the organisms. Research is now in progress in this field.

Reservoir construction will have an important effect on the biological character of the various streams in the Kansas River Basin. From a public water supply standpoint, this effect may be adverse to the extent that taste and odor problems at surface water supply cities located below the reservoirs may be made more difficult especially during the summer flow regulation period. From the standpoint of other quality characteristics, reservoir flow regulation is generally beneficial.

Sewage Treatment Needs

Sewage treatment needs and the status of each proposed municipal project are presented in the summary Table No. 8. For convenience, the table is broken down by States and major sub-basins. Details regarding sewage treatment needs at or near each city are presented in the sub-basin discussions.

Flow and Treatment Requirements

Desirable Stream Flows - In considering the matter of desirable stream flows from the standpoint of pollution abatement, the basic assumption is made that critical pollution situations will be corrected, either because of State action, because of damage suits, for the protection of public health, or to fulfill a demand for clean streams. In the typical case of pollution from a city or industry entering a stream, the objectionable conditions resulting can be corrected in large measure by treatment, the degree or efficiency of treatment required being dependent on the size of the city or industry in relation to the minimum flow in the stream. Where flows are too low to permit partial treatment to remedy the situation, secondary or complete treatment may be required. In such a situation it is possible, through increasing the flows, to construct a partial treatment plant and thus reclaim the polluted stream at lesser cost. The savings in cost quite justifiably can be credited to the increase in flow as a benefit. Normally the

Table 8

Kansas River Basin

Sewage Treatment Requirements and Recommendations
Cities With Over 1,000 Sewered Population Equivalent

Nebraska

City	Remarks	Status*
Republican Basin		
Superior	New plant needed	8
Red Cloud	New plant needed	8
Franklin	New plant needed	8
Holdrege	Present treatment adequate	1
Alma	New plant needed	8
Orleans	New plant needed	8
Beaver City	Higher degree of treatment needed	8
Oxford	Present treatment adequate	1
Arapahoe	New plant needed	8
McCook	Replace obsolete plant Higher degree of treatment needed	4
Imperial	Present treatment adequate Operation faulty	1
Benkelman	Replace obsolete plant Higher degree of treatment needed	8
Big Blue Basin		
Fairbury	New plant needed	8
Deshler	Present treatment adequate	1
Hebron	New plant needed	8
Ingleside	Present treatment adequate	1
Minden	Present treatment adequate	1
Wymore	Present treatment adequate	1
Beatrice	New plant needed	3
Friend	Present treatment adequate	1
Geneva	Present treatment adequate	1
Crete	More capacity needed	9
York	Operation faulty	-
Sutton	Present treatment adequate	1
Hastings	More capacity needed	2
Milford	New plant needed	8
Seward	New plant needed	4
Aurora	Present treatment adequate	1
Stromsburg	New plant needed	6
David City	Present treatment adequate	1

Kansas

City	Remarks	Status*
Main Stem Basin		
Kansas City	New plant needed	6
Olathe	Present treatment plant adequate	1
Bonner Springs	New plant needed. Cannery wastes	8
Tonganoxie	Present city treatment adequate. Treatment planned for milk plant wastes by industry.	1
Eudora	New plant needed	8
Lawrence	New plant needed	8
Valley Falls	Replace obsolete plant	8
Holton	Present treatment adequate	1
Horton	Present treatment adequate	1
Topeka	More capacity needed	6
Alma	Present treatment adequate	1
St. Marys	New plant needed	8
Wamego	New plant needed	8
Manhattan	New plant needed	8
Fort Riley	Present treatment adequate	1
Big Blue Basin		
Frankfort	New plant needed	8
Blue Rapids	New plant needed	8
Waterville	New plant needed	8
Hanover	New plant needed	8
Washington	Present treatment adequate	1
Marysville	New plant needed	8

Kansas (cont.)

City	Remarks	Status*
Republican Basin		
Junction City	New plant needed	5
Clay Center	New plant needed	8
Belleville	Present treatment adequate	1
Concordia	New plant needed	8
Mankato	Present treatment adequate	1
Norton	Present treatment adequate	1
Colby	Present treatment adequate	1
Atwood	Present treatment adequate	1
Oberlin	Present treatment adequate	1
Goodland	Present treatment adequate	1
St. Francis	Present treatment adequate	1
Smoky Hill Basin		
Herington	Present treatment adequate	1
Chapman	New plant needed	8
Abilene	Higher degree of treatment needed	8
Salina	Replace obsolete plant. Higher degree of treatment needed	2
Lindsborg	Present treatment adequate	1
Ellsworth	Present treatment adequate	1
Wilson	Present treatment adequate	1
Russell	Present treatment adequate	1
Hays	Present treatment adequate	1
Ellis	Present treatment adequate	1
Wakeeney	Higher degree of treatment needed	2
Oakley	Present treatment adequate	1
Sharon Springs	Present treatment adequate	1
Solomon Basin		
Minneapolis	New plant needed	8
Beloit	New plant needed	8
Downs	Replace obsolete plant	8
Smith Center	Present treatment adequate	1
Phillipsburg	Present treatment adequate	1
Osborne	Replace obsolete plant	8
Stockton	Present treatment adequate	1
Hill City	Present treatment adequate	1
Hoxie	More capacity needed	2
Saline Basin		
Lincoln	Present treatment adequate	1
Plainville	Present treatment adequate	1

Colorado

City	Remarks	Status*
Republican Basin		
Wray	Higher degree of treatment needed	9
Burlington	Present treatment adequate	1
Akron	Present treatment adequate	1
Yuma	Present treatment adequate	1

* Status:
1. Control or plant satisfactory.
2. Construction under way.
3. Plans approved - finance arranged.
4. Plans approved - finance not arranged.
5. Plans submitted - approval pending.
6. Plans or report under way.
7. Under notice or order - no progress known.
8. Project needed, no program known.
9. Status not definitely known.

cost of flow increases is greatly in excess of the benefits to be derived, although where a number of points of pollution, one below the other, are involved, benefits are increased proportionately. With most municipal and industrial waste discharges no degree of flow increase can entirely eliminate the need for treatment as a minimum of primary treatment is required to prevent sludge deposits at the outlet and eliminate objectionable floating material.

The provision of increased flow in the interest of pollution abatement on streams such as in the Kansas River Basin, particularly in the upper reaches, is subject to a number of complicating factors. One of the principal factors is a question as to whether flow releases from upstream reservoirs would actually reach a point of pollution or would be lost enroute by evaporation, seepage, or possible interception by irrigation users. Other than a discussion in the Republican River section of this report, only minor consideration has been given to this factor in connection with the present report, and any conclusions presented must be qualified for that reason.

A consideration of possible pollution benefits from irrigation water return must include the fact that, to be of any tangible benefit to pollution problems, flows must be provided continuously and not only during months of the irrigation season. For example, there can be little saving in the cost of sewage treatment if a high degree of treatment is required during certain months when irrigation water return is not available.

In general the desirable flow for pollution abatement is dependent on water temperatures, being much higher during the hot weather months than it is during the winter months. The following tabulation, using average water temperatures of the Missouri River at Kansas City, Missouri indicates a typical month-to-month variation in flow needs, using June, July, August and September flows as 100 per cent (Table No. 9):

Table 9 Kansas River Basin - Seasonal Variations of Desirable Minimum Monthly Mean Flows

Month	Approximate Average Stream Temperature* °F	°C	Minimum Monthly Mean Flow as Per Cent of Summer Season Flow
January	34	1	20
February	34	1	20
March	37	3	25
April	54	12	40
May	66	19	60
June	72	22	100
July	81	27	100
August	79	26	100
September	75	24	100
October	59	15	45
November	48	9	30
December	36	2	20

* These data comparable to data collected in Kansas River Basin during this survey.

Flows provided in accordance with this schedule should not deviate downward from the value set by the schedule by an appreciable amount except during unusually dry years occurring no oftener than once in ten years. At least 80 per cent of the indicated flows should be provided during such years.

In general, flows are estimated, compared and discussed on the basis of the monthly mean value. Where low flow regulation is to be practiced and an estimate is given of the desirable flow, this is the minimum monthly mean. In order to achieve benefits and to prevent damage, low flow regulation must be such that there will be reasonable uniformity of discharge at the point of pollution throughout the month.

Recommended Flows - It is recommended that flows classed as "Desirable" be maintained by any flow regulation program. These flows are based upon a minimum dissolved oxygen objective of 5.0 ppm which is a necessary oxygen level in streams for the maintenance of a balanced aquatic life, and upon a minimum of primary treatment of sewage at all cities. Flow estimates are also based upon existing pollution and suitable adjustments must be made where future growth warrants them.

It is not the intention of this report to set forth the foregoing objectives as high standards for stream quality or sewage treatment. "Desirable" flows provide the minimum sanitation needs of the stream and, depending upon local conditions, it may be desired to make the stream available for higher uses. In such cases a higher degree of sewage treatment, or increased minimum flow levels, or both, would result in better and more dependable stream quality.

In connection with studies of a proposed flow regulation program in the Republican River Basin, "Secondary Treatment Desirable Flows" based upon a dissolved oxygen objective of 5.0 ppm and secondary treatment have also been estimated. This was done to provide a basis for comparing the costs of a higher degree of sewage treatment with the value of additional water which because of this higher degree of treatment would become available for irrigation diversion.

Minimum Flows- The foregoing discussion deals with flows which are desirable and which may have monetary value if provided. In fortunate locations the normally expected unregulated minimum flow is more than adequate to assimilate partially treated sewage without serious oxygen depletion, and this is the case at many locations in the Kansas River Basin. At other locations the minimum flow is insufficient to assimilate pollution loads without the highest possible degree of sewage treatment. In the central and western portions of the Basin, minimum flows frequently approach zero, and experience has shown that, even with the highest degree of treatment, a stream with no flow above a point of pollution cannot be reliably maintained in satisfactory condition. However, such periods of zero or extremely low flow are usually infrequent and of relatively short duration. It is not sufficient, therefore, to maintain minimum flow conditions by regulation on the assumption that the resulting stream would be no worse than prior to reservoir and irrigation development. Actually, the stream would be in worse condition practically all of the time, and would be no worse only at times of normally expected unregulated minimum flow.

Treatment Requirements - Studies have been made for the purpose of determining sewage treatment requirements under minimum flow conditions as of the period of survey and for estimated minimum flows to be maintained by the proposed flow regulation program. Present treatment requirements were based upon minimum flow expectancies as of the survey period. If these minimum expected flows are raised by the flow regulation program, benefits to the cities in the form of a lower required degree of treatment may result. On the other hand, if present minimum expected flows are reduced by such a program, the cities may be damaged to the extent that a higher degree of sewage treatment may be necessary to maintain satisfactory oxygen conditions in the stream. Where studies indicate that primary treatment is adequate at present minimum flows, there can be no benefits ascribed to increased minimum flow levels by regulation, as primary treatment of sewage is a normal basic requirement for all cities.

Results of these studies are presented in the sub-basin sections of this report.

The dissolved oxygen objective selected for these studies is a minimum of 5.0 ppm. This is a minimum oxygen level for the proper maintenance of a balanced aquatic life.

In addition to the usual man made sources of pollution, pollution added by surface wash of land areas is an important factor in explaining stream behavior in the Kansas River Basin. Man made pollution is defined for purposes of this report as that which is contributed by communities and industries along a river, and its location and magnitude are known. Surface wash pollution is an additional load placed upon the oxygen resources of the stream. Its location is indefinite, and the amount added depends directly upon the character of the watershed and land surface, as well as the magnitude of run-off.

The dissolved oxygen characteristics of streams in this basin vary considerably, depending upon the extent of surface wash pollution. At low stream stages there is little or no surface wash pollution present, and the dissolved oxygen profile describes the usual picture of sag and recovery below a major source of pollution. However, at higher flows the addition of large and extremely variable amounts of surface wash pollution can completely distort the expected profile. The picture of self-purification of streams in the Kansas River Basin is further complicated by the activity of algae, which produce oxygen in varying amounts by photosynthesis at low stream flows.

The principal interest is in stream behavior at critical or minimum flows, at which there is little or no surface wash pollution, and this is the governing condition. Therefore, estimates of sewage treatment requirements have been based upon minimum flow conditions, with a relatively small allowance for surface pollution.

Natural Self-Purification - The economical treatment of sewage requires that advantage be taken of the stream's ability to assimilate a certain amount of pollution without serious lowering of dissolved oxygen. Estimates have therefore been made of the natural self-purification capacity of streams in the Kansas River Basin in determining required degrees of treatment.

The studies indicate that in the main streams of the Basin the rate of deoxygenation, or rate at which organic pollution utilizes dissolved oxygen from the stream water, is of a magnitude that would be expected based on experience elsewhere. However, the rate of reoxygenation is somewhat greater than usually encountered in streams with physical characteristics such as are found in the Kansas

River Basin. The rate of reoxygenation actually represents the rate at which oxygen is replenished in the stream by both surface reaeration and algae. It cannot, therefore, be considered as a constant at any particular location, but varies with flow, as algae are effective oxygen producers at low flows, but contribute much less oxygen at the higher stream flows, due to inhibition of photosynthesis by high turbidity. Consequently, the rate of reoxygenation may be expected to be relatively high at low stream flows, decreasing somewhat at higher flows.

A factor of some importance in connection with atmospheric reoxygenation of a stream is the "ponding" of the stream as a result of the construction of dams. This changes substantial reaches of the normally free flowing stream into more sluggish bodies of water which are nearly equivalent to lakes. Reduction in turbulence will materially reduce atmospheric reaeration, a major source of oxygen. On the other hand, tending to offset this will be the fact that the ponding effect will favor the growth of chlorphyllaceous organisms (algae) which, in their metabolism, utilize carbon dioxide and give off oxygen, thus having a favorable effect on the oxygen resources of the water. The ponding of a stream favors the growth of these organisms because the velocity is reduced to a low value, large water areas are exposed to sunlight and the ponded water has a low turbidity much of the time. (For possible adverse effects of these organisms see the discussion on biological problems in this section of the report).

It is common to all of the streams studied that at high stream stages, dissolved oxygen levels are relatively low, while at low flows the dissolved oxygen is generally higher than expected. This is opposed to the usual situation, and may be explained as follows:

(1) At higher stream flows there is a decided increase in B.O.D. (biochemical oxygen demand) and coliform organisms due to surface wash, placing a higher pollution burden upon oxygen resources. At the same time turbidities increase sharply, inhibiting algal activity. The combination of effects results in a greatly increased pollution load and a lower rate of reoxygenation, causing dissolved oxygen results to be lower than might be expected.

(2) At low stream stages, with little or no surface wash pollution, the B.O.D. and coliform results more nearly represent man made contributions. Turbidity is quite low, and algae are more effective oxygen producers.

> The result is that pollution loads are normal, while the rate of reoxygenation is somewhat higher, and dissolved oxygen results are relatively high except immediately below major sources of pollution.

Conclusions - Surface wash pollution is an important factor in streams of the Kansas River Basin. However, it has a negligible effect at critical flows, and the sources of man made pollution are the major factor in determining treatment requirements at critical flows.

Deoxygenation is normal, while the rate of reoxygenation is relatively high at low flows. As a direct result, the streams are generally able to assimilate somewhat greater pollution loads at low flows than might be expected.

Critical flows have been estimated at various locations, and are based upon man made pollution contributions, with a relatively minor allowance for surface wash pollution. In these calculations, algae have been allowed a contribution to oxygen resources, as this source of oxygen is indicated to be reasonably dependable at low flows.

Sewage treatment requirements based upon sanitation needs of the streams have been determined for both present minimum flow expectancies and minimum flows expected to be provided by a flow regulation program where a regulation program is under consideration. Requirements for treatment at the two flow levels have been compared in estimating the benefits or damages which would result from the regulation program.

Benefits and Damages

Desirable stream flows at various locations in the Kansas River Basin have been estimated and are based solely upon a minimum dissolved oxygen objective of 5.0 ppm. (Other quality factors were not considered in making these estimates). In estimating these flows, primary treatment of sewage has been considered a basic requirement for all cities. Secondary treatment has been considered where stream conditions and water use indicate the need for such treatment.

Benefits and damages resulting from various flow situations have been assigned a monetary value, based upon estimated annual costs of primary, intermediate and secondary treatment of sewage for certain communities. Per capita costs of treatment plant construction, based upon the size of city and degree of treatment have been applied to the various situations. These costs are taken from a study of such costs in this area. Initial costs have been expressed as annual charges, based upon a 20-year life and 3½ per cent interest rate. Annual per capita costs of operation and maintenance, also based on size of city and degree of treatment, represent adjusted figures from a study of these costs in the Ohio River Basin, as sufficient data for a study of such costs in the Kansas River Basin States were not available.

In cases where the normally expected minimum monthly average flow is less than the desirable flow, primary treatment is inadequate and a higher degree of treatment is required. In this case, should a flow regulation program provide a minimum monthly average flow equal to or greater than the desirable flow, primary treatment would be adequate, with resulting benefits to the city in the form of a lower required degree of treatment. No benefits are possible when the normally expected minimum flow is equal to or greater than the desirable flow corresponding to primary treatment.

In situations where the normally expected minimum monthly average flow is equal to or greater than the desirable flow, primary treatment of sewage is adequate. Should the flow regulation program provide a minimum flow which is less than the desirable, a higher degree of treatment will be necessary, with resulting damages to the city. However, no damages are possible when the regulated flow is greater than the desirable flow, even though it may represent a reduction of the normally expected minimum flow.

Public Health Aspects of Polluted Irrigation Waters

Inasmuch as extensive irrigation projects are being planned for the Kansas River Basin it is considered necessary to discuss the health aspects of this important water use.

There are significant public health problems inherent in the use of sewage polluted irrigation waters, but at present there exist no completely reliable yardsticks for the measurement of hazards under specific conditions. Although some State health departments (See Appendix "F") have promulgated standards, no simple generally applicable standards such as those available for drinking water have been developed for the sanitary quality of irrigation waters. The principal lack of information lies in the field of epidemiology. While planning is underway for the conduct of extensive epidemiological studies in this field, no reliable data are yet available. The development of standards must await the results of epidemiological investigations and in addition, further bacteriological studies of irrigation waters, irrigated land and crops. Studies in the latter field are now underway. Appendix "F", which contains a partial review of the literature on health hazards associated with irrigation, suggests that the use of polluted irrigation waters may be responsible for a number of diseases. An important consideration is the type of crop irrigated. In general, low growing fruits and vegetables, such as celery, cabbage, lettuce, carrots and strawberries which are or can be consumed raw probably offer the most serious hazard. Of less, but by no means neglible danger, are field crops, such as corn, which have been irrigated with polluted water.

Possible hazards to livestock, particularly dairy cattle, must receive consideration. Farm water supplies also may be adversely affected in some cases.

Irrigation with sewage polluted water has the effect of removing polluted water from points of only limited access; i.e., the streams, and distributing the pollution over a much larger area where it may come in contact with fruit, vegetables, grains, livestock, etc., depending on the local irrigation situation. The consequence of this in terms of the probability of the transfer of infectious material from a diseased host to a well person or animal must not be overlooked.

Of great importance in any stream sanitation study is the sanitary survey; i.e., the location of the points of potential danger. Analyses of irrigation waters must be interpreted in the light of such survey facts if the correct weight is to be given them. For example, the presence of coliform organisms in a headwater stream, even in large numbers, is much less significant than when these same organisms are noted below a known sewer outfall. This report presents detailed information on the sources of pollution. The time factor is of importance also. A small amount of pollution near the point of irrigation water use may, from a health standpoint, have much more significance than a much higher pollution load discharged into the stream a considerable distance away. This is true because bacterial contamination is quite rapidly reduced in a flowing stream. Also, storage in reservoirs generally has the effect of increasing the time of flow from a point above the reservoir to one below, thus resulting in the destruction of large numbers of bacteria.

Sewage treatment processes remove large numbers of bacteria but the usual municipal sewage treatment plant is not designed or operated to produce an effluent free from bacteria or other organisms pathogenic to man. The efficiency of various treatment processes as far as bacteria removal is concerned is roughly as shown in Table 10.

Table 10 - Bacterial Efficiency of Various Sewage Treatment Processes (1)

Type of Treatment	Per Cent Removal of Bacteria
Primary treatment	25 to 75
With chlorination	90 to 95
Chemical precipitation treatment	40 to 80
Secondary treatment--	
Complete trickling filter plant	90 to 95
Activated sludge plant	90 to 98
Intermittent sand filtration plant	95 to 98
Any of above with chlorination	98 to 99

Chlorination is not generally practiced at sewage treatment plants in the Kansas River Basin. The same statement applies to the majority of sewage treatment plants in the United States.

In summary, it may be said that:

(a) The use of sewage polluted irrigation water presents a public health hazard.

(b) No generally applicable standards for the sanitary quality of irrigation water are available at present. Research on this problem is now in progress.

(c) In interpreting the results of bacterial analyses of irrigation waters, careful consideration must be given to sanitary survey information.

(d) Sewage treatment as generally practiced in the Kansas River Basin removes large numbers of bacteria but plant effluents cannot be considered free from pathogenic organisms.

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(1) Imhoff - Fair, Sewage Treatment, p. 6 (John Wiley & Sons, 1940)

MAIN KANSAS RIVER AND MINOR TRIBUTARIES

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MAIN KANSAS RIVER AND MINOR TRIBUTARIES

SYLLABUS

The Kansas River is formed by the confluence of the Republican and Smoky Hill Rivers at Junction City, Kansas, and flows eastward to discharge into the Missouri River at Kansas City, Kansas. The valley of the Kansas River is a fertile region devoted to agricultural pursuits and the processing of farm products. Five municipalities secure public water supplies from surface sources, Topeka and Lawrence, Kansas, drawing directly upon the Main Stem. Sources of pollution are large, but adequate minimum flows and considerable distances between sources of pollution indicate that, generally, a minimum of primary treatment of sewage would prevent nuisances and health hazards. Topeka, which discharges wastes above Lawrence, should continue action toward a higher degree of waste treatment. Of four reservoir projects presented, only one, on the Delaware River, is in the proposed stage. However, reservoir operation in other sub-basins may affect the water supplies at Topeka and Lawrence, particularly should such operation cause a predominance of high chloride water from the Saline and Smoky Hill Rivers in the Kansas River. It is essential that reservoir operation schedules be coordinated on a basin-wide plan.

CONCLUSIONS

(1) There are five municipalities that obtain public water supplies from surface sources in the Main Kansas River Basin. These furnish an average of 9.59 million gallons per day to a total population of 122,300. Lawrence, Kansas, is the only one of these cities located below where Perry Reservoir will discharge to the Kansas River.

(2) Water from underground sources is supplied to a total population of 56,186 in 22 municipalities and one Army post (Fort Riley) in the Main Kansas River Basin at the average rate of 6.525 million gallons per day.

(3) Sewage from a population of 258,580 and industrial wastes with a sewered population equivalent of 798,780, or a total of 1,057,360, are produced in the Main Kansas River Basin. This is reduced by treatment in municipal sewage treatment plants to a load equivalent to a sewered population of 939,265 before discharge. If Kansas City, Kansas which is located at the mouth of the Kansas River is excluded, the total load before treatment is 280,360. This is reduced by treatment to a population equivalent of 162,265.

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Excluding Kansas City, Kansas, the sewered population equivalent connected to sewage treatment plants is 69 per cent of the total.

(4) New sewage treatment plants or plant improvements are needed at 14 of the 19 sewered cities in the Main Kansas River Basin. These improvements include industrial waste treatment and treatment facilities for State institutions. Improved maintenance and operation are needed in some cases.

(5) Main stem flows needed for satisfactory dilution of treated sewage with the maintenance of an adequate oxygen reserve are less than the normal summer season minima, thus no organic pollution control benefits can be credited to reservoir regulation.

(6) Public surface water supply problems along the main stem are those associated with frequent high bacterial loadings, occasional high chloride concentrations, and taste and odor control. The latter is an especially serious problem at both Topeka and Lawrence, Kansas, and may be made more difficult by reservoir operations.

(7) In diverting water to irrigation use consideration must be given to the possible effect of such diversion on main stem mineral quality at Topeka and Lawrence, since major tributaries of the Kansas River at times have high concentrations of mineral substances which may affect the water supplies of these cities.

RESERVOIR PROJECTS

Table K-1 presents summarized information on reservoir projects in the Main Kansas River Basin, according to information obtained from the Corps of Engineers. Of the 4 reservoirs, Perry is proposed, and Linwood, Clinton and Onaga are under investigation. Perry is located 7.7 miles upstream on the Delaware River. The drainage area of the Perry Reservoir is 1,059 square miles, or 19 per cent of 5,554 square miles in the main stem drainage basin of the Kansas River.

DESCRIPTION

The Kansas River is formed by the confluence of the Republican and Smoky Hill Rivers at Junction City, Kansas, and flows generally eastward approximately 169 river miles to its mouth at Kansas City, Kansas, where it joins the Missouri River. The principal tributaries exclusive of the Big Blue River, entering the Kansas River between Junction City and the mouth are shown in Table K-2.

Table K-1 Main Kansas River and Minor Tributaries - Reservoir Data (1)

Reservoir	Tributary Stream	Miles to Mouth		Storage, Acre-Feet				Area Max. Pool Acres	Status
		Kansas River	Tributary Stream	Silt and Conservation	Irrigation	Flood Control	Total		
Linwood	Stranger Creek	33.6	4.7	-	-	-	-	-	Under Invest.
Clinton	Wakarusa River	40.7	31.8	-	-	-	-	-	Under Invest.
Perry	Delaware River	63.3	7.7	173,000	0	187,000	360,000	14,120	Proposed
Onaga	Vermillion Creek	116.9	23.9	-	-	-	-	-	Under Invest.

(1) Data from Corps of Engineers.

Table K-2 - Main Kansas River and Minor Tributaries

Stream	Miles Above Kansas River Mouth	Drainage Area Square Miles
Kansas River		60,060
Stranger Creek	33.6	533
Wakarusa River	40.7	516
Delaware River	63.3	1,144
Soldier Creek	80.2	304
Mill Creek	101.5	408
Vermillion River	116.9	521

The annual rainfall varies from about 31" in the western section of the Main Stem Basin to 38" in the extreme eastern end, with an average rainfall over the drainage basin of approximately 35" per year. The main stem of the Kansas River flows through a fertile valley that has both industrial and agricultural activity.

Table K-3 lists 38 municipalities in the Main Kansas River Basin. The 4 large cities with their 1940 Census population are Kansas City 121,458, Topeka 67,833, Lawrence 14,390, and Manhattan 11,659. Of the remaining cities, 8 have 1940 Census populations between 1,000 and 4,000, and 26 have populations less than 1,000. The 1948 population estimates indicate substantial growth of the larger cities but only minor changes in the population of the smaller ones.

PRESENTATION OF DATA

Public Water Supplies

There are 5 municipalities in the basin of the Main Kansas River and minor tributaries that obtain public water supplies from surface sources (Table K-4). All of these supplies are coagulated, settled, filtered and chlorinated.

Lawrence and Topeka obtain water directly from the Main Stem and supply a total population of 113,900 with an average of 8.83 million gallons per day. The cities of Olathe, Horton and Onaga obtain supplies from tributaries and supply a total population of 8,400 with an average of 0.76 million gallons per day.

Table K-5 lists 22 municipalities and one Army post (Fort Riley) that obtain water supplies from ground sources in the Main Stem

Table K-3 Main Kansas River & Minor Tributaries

Population of Cities

City	Population - U. S. Census			
	1920	1930	1940	1948*
Alma, Kansas	789	811	776	759
Belvue, Kansas	199	186	226	174
Bonner Springs, Kansas	1,599	1,837	1,837	2,973
De Soto, Kansas	345	384	383	368
Effingham, Kansas	616	646	676	582
Eudora, Kansas	627	599	603	795
Everst, Kansas	403	386	375	410
Goff, Kansas	398	437	339	311
Havensville, Kansas	333	263	232	223
Holton, Kansas	2,703	2,705	2,885	2,684
Horton, Kansas	4,009	4,049	2,872	2,802
Kansas City, Kansas	101,177	121,857	121,458	147,103
Lawrence, Kansas	12,456	13,726	14,390	18,011
Lecompton, Kansas	310	288	250	241
Lenexa, Kansas	472	452	502	816
Linwood, Kansas	364	295	299	232
McLouth, Kansas	575	517	515	474
Manhattan, Kansas	7,989	10,136	11,659	13,484
Meridan, Kansas	422	390	421	378
Muscotah, Kansas	427	365	331	276
Nortonville, Kansas	696	606	562	586
Ogden, Kansas	596	418	494	553
Olathe, Kansas	3,268	3,656	3,979	5,062
Onaga, Kansas	838	930	741	878
Oskaloosa, Kansas	700	733	800	728
Perry, Kansas	481	418	392	386
Riley, Kansas	364	431	392	394
Rossville, Kansas	664	701	601	552
St. George, Kansas	211	216	203	247
St. Marys, Kansas	1,321	1,304	1,132	1,231
Shawnee, Kansas	-	553	597	782
Silver Lake, Kansas	260	336	362	265
Tonganoxie, Kansas	971	1,109	1,114	1,158
Topeka, Kansas	50,022	64,120	67,833	87,001
Valley Falls, Kansas	1,218	1,238	1,241	1,135
Wamego, Kansas	1,585	1,647	1,767	1,875
Westmoreland, Kansas	386	501	532	433
Winchester, Kansas	386	418	415	349

* Estimated -- Kansas State Board of Agriculture Bulletin "Population of Kansas" August 24, 1948

Table K-4 Main Kansas River & Minor Tributaries

Municipal Surface Water Supplies

Stream and Municipality	State	Miles Above Mouth Kansas River	Miles Above Mouth Tributary	Treatment (1)	Population Served	Average Consumption M.G.D.
Mill Creek		16.0				
Olathe	Kans		12.0	FD	5,000	0.40
Lawrence (3)	Kans	50.2		FDH	26,900 (2)	1.70
Delaware River		63.3				
Horton	Kans		55.0	FD	2,700	0.30
Topeka (3)	Kans	82.3		FDH	87,000	7.13
Vermillion River		116.9				
Onaga	Kans		35.8	FD	700	0.06
Total					122,300	9.59

(1) Treatment -
F - Coagulated, Settled, Filtered
H - Softened
D - Chlorinated

(2) Including 8,900 Kansas University Students

(3) Supplementary ground supplies have been developed for occasional use at Lawrence and Topeka.

Note: Standby plant at Sunflower Ordnance Works, K-29.4; Peak use of 43 M.G.D. when plant is operating; Treatment - FD

Table K-5 Main Kansas River & Minor Tributaries

Municipal Water Supplies From Ground Sources

Municipality	State	Source (1)	Treatment (2)	Population Served	Average Consumption M. G. D.
Alma	Kans	SW	N	700	0.07
Bonner Springs	Kans	SW	ID	2,900	0.12
De Soto	Kans	SW	DH	500	0.03
Effingham	Kans	DW	N	330	0.04
Eudora	Kans	SW	FDI	795	0.05
Everest	Kans	SW	Dp	220	0.01
Fort Riley	Kans	W	D	13,000	2.10
Goff	Kans	SW	N	200	0.01
Havensville	Kans	SW	N	210	0.01
Holton*	Kans	SP,SW	D	2,650	0.20
McLouth	Kans	SP	N	350	0.01
Manhattan	Kans	SW	FDHI	21,375 (3)	2.00
Nortonville	Kans	DW	N	440	0.02
Ogden	Kans	SW	N	400	0.05
Oskaloosa	Kans	SW	N	540	0.02
Riley	Kans	DW	D	350	0.02
St. Marys	Kans	SW	D	1,200	0.12
Sunflower	Kans	SW	FDH	5,400	1.00
Tonganoxie	Kans	SW	DH	900	0.20
Valley Falls	Kans	SP,SW	D	1,300	0.125
Wamego	Kans	SW	D	1,786	0.28
Westmoreland	Kans	SW	N	400	0.03
Winchester	Kans	SP	N	240	0.01
	Total			58,186	6.525

Holton* - Impoundment under construction

(1) Source - W - Wells
SW - Shallow Wells
DW - Deep Wells
SP - Springs

(2) Treatment - N - None
D - Chlorinated
Dp - Partially Chlorinated
F - Coagulated, Settled, Filtered
I - Iron removal
H - Softened

(3) Including 7,500 Kansas State College students.

Kansas River Basin. These supply a total population of 56,186 with an average of 6.52 million gallons per day. The largest of these supplies is at Manhattan where 21,375 people are furnished with an average of 2.0 million gallons per day.

State Geological Survey of Kansas Bulletin 41, entitled "Ground Water Supplies in Kansas Available for National Defense Industries," indicates that large ground water supplies are available in the valley of the main stem of the Kansas River. This bulletin states that most individual wells will produce 1,000 g.p.m. and that at favorable locations upwards of 10 M.G.D. can be obtained. However, the water has a hardness of 300-900 p.p.m. and has enough iron, and in some cases manganese, to require treatment.

Topeka and Lawrence have developed supplementary ground water supplies. In 1941 a study of ground water resources and quality was conducted in the Lawrence, Kansas, vicinity by the State and U. S. Geological Surveys in cooperation with the Kansas State Board of Health. This study indicated a copious supply of ground water available on the north side of the Kansas River opposite Lawrence. Although high in hardness and iron, the quality would be quite satisfactory following softening and iron removal treatment. However, on the south side where the water plant and principal portion of the city are located only limited amounts of ground water were available. The city considered the possibility of developing a ground water supply on the north side of the river valley and placing the Kansas River supply on a standby basis but cost factors and scarcity of materials led to the abandonment of this idea in favor of the development of a supplementary ground water supply of more limited capacity on the south side of the River. A somewhat similar situation exists at Topeka, Kansas, in that this city also makes use of a supplementary ground water supply.

Sources of Pollution

Table K-6 summarizes the location and magnitude of significant sources of organic pollution, including data on industrial wastes discharged to streams of the Main Stem Kansas River Basin. As noted in the table, the total population connected to sewers is 258,580. However, if Kansas City, Kansas, located at the mouth of the stream with a population of 103,000 connected to sewers, is deducted, the total is 155,580. The total sewered population equivalent is 1,057,360. Here again, if Kansas City is deducted, the total is 280,360. There is, therefore, a sewered population equivalent industrial waste load of 124,780, excluding Kansas City, or 798,780 including Kansas City. The problem of pollution created by Kansas City, Kansas, on the Kansas River, is a special problem that does not affect this stream except near its mouth and is as much a problem of the Missouri River as of the Kansas River. The amount of pollution discharged to the Missouri

Table K-6 **Main Kansas River & Minor Tributaries**

Sources of Pollution Including Industrial Wastes Expressed as Sewered Population Equivalent(B.O.D.)

		Miles Above Mouth		Population Connected to Sewers	Treatment (1)	Sewered Population Equivalent (B.O.D.)	
Municipality	State	Kansas River	Tributary			Untreated	Discharged
Kansas City	Kans	2.5		103,000	N	777,000	777,000 (2)
Mill Creek		16.0					
Olathe	Kans		12.0	4,300	S	4,300	1,900
Bonner Springs	Kans	20.2		1,850	N	15,540	15,540
Kill Creek		29.5					
Sunflower	Kans		2.0	5,000	S	5,000	1,250
De Soto	Kans	30.0		320	N	320	320
Stranger Creek		33.6					
Tonganoxie Creek			16.0				
Tonganoxie	Kans		3.1	1,000	S	5,000	3,560
Eudora	Kans	45.9		750	N	1,290	1,290
Lawrence	Kans	50.2		26,900 (3)	N	39,400	39,400
Delaware River		63.3					
Valley Falls	Kans		29.7	1,000	N	1,945	1,945
Elk Creek			42.6				
Holton	Kans		11.6	2,500	S	4,010	1,000
Grasshopper Creek			50.0				
Horton	Kans		5.6	2,400	S	3,355	840
Topeka	Kans	82.3		70,800	P	154,600	58,700
Mill Creek		101.5					
Alma	Kans		18.0	740	S	1,000	250
St. Marys	Kans	107.7		1,175	P	1,555	980
Vermillion River		116.9					
Onaga	Kans		25.0	775	S	775	500
Wamego	Kans	123.6		1,520	N	1,520	1,520
Manhattan	Kans	144.1		21,100 (4)	N	27,300	27,300
Ogden	Kans	158.9		450	N	450	450
Fort Riley	Kans	166.7		13,000	PS	13,000	5,500 (5)
	Total			258,580		1,057,360	939,265

(1) Treatment -
N - None
P - Primary
S - Secondary

(2) Includes estimated population equivalent of 50,000 discharged to Missouri River.

(3) Includes 8,900 Kansas University students.

(4) Includes 7,500 Kansas State College students.

(5) Includes some discharge to the Republican River.

Note: Sewage from Mission Township Main Sewer District No. 1 located in Northeast Johnson County, Kansas, outside the Kansas River Basin, will be pumped over the divide to a secondary treatment plant located near Turkey Creek, a minor tributary, which enters the Kansas River at mile 3.5. This system will be placed in operation in July or August, 1949, and at the start will serve a population of about 15,000. No significant amounts of industrial wastes will be discharged into this system. The sewage plant effluent will be chlorinated and pollution from this source should be negligible.

River from Kansas City, Kansas, is equivalent to a sewered population of about 50,000.

Of the 19 cities listed in Table K-6, nine (including Fort Riley) with a sewered population equivalent of 191,040 have secondary treatment plants, one with a sewered population equivalent of 1,555 has primary treatment, and eight with a sewered population equivalent of 87,765 discharge raw sewage. The remaining municipality, Kansas City, discharges raw sewage and industrial wastes equivalent to a sewered population of 777,000. Excluding Kansas City, the sewered population equivalent receiving no treatment, primary treatment and secondary treatment is approximately 31%, 1% and 68%, respectively, of the total.

Laboratory Results

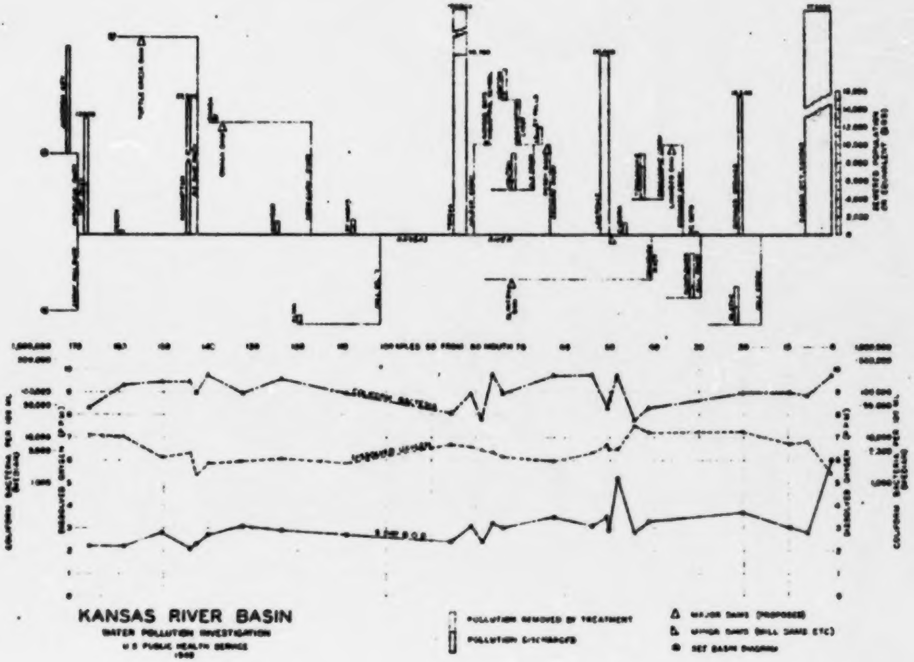
Average summer season dissolved oxygen and B.O.D. data and median coliform results as well as sources of pollution are shown on Figure K-1. Similar winter season data are presented in Figure K-2. These data for the summer season are also indicated on Figures 6, 7, and 8. Average and maximum chloride results are given on Figures 9 and 10. A summary of individual results, together with corresponding discharge data, is presented in Appendix "H".

Average summer dissolved oxygen results are, for the most part, above the 6 ppm level and at no station did the average of the survey results show less than 5 ppm during the summer months. Average winter results are practically double the summer averages. Individually, the summer survey results ranged from a minimum of 2.4 ppm at River Mile 142.7 below Manhattan, Kansas, to maxima of over 8 ppm at various points. Individual winter results showed less variation ranging from a minimum of about 11 ppm at several points to maxima of over 14 ppm. Winter and summer average dissolved oxygen consistently exceeded the corresponding average B.O.D. except below the heavy organic pollution load from Kansas City, Kansas, where a small average deficiency is indicated during the summer season and a substantial one during the winter months.

Summer average B.O.D. values are, in general, in the range 2 to 4 ppm, except below Lawrence and Kansas City, Kansas, where they exceed 5 ppm. Winter average results present a somewhat similar picture. Substantial increases are noted below Lawrence and Kansas City, Kansas.

Summer median coliform bacteria results show considerable variation but are usually in excess of 50,000 per 100 ml. Winter median results are in general lower but peak values of about 100,000 M.P.N. per 100 ml. were found below Manhattan, Topeka, Lawrence and Kansas City, Kansas.

FIG K-1



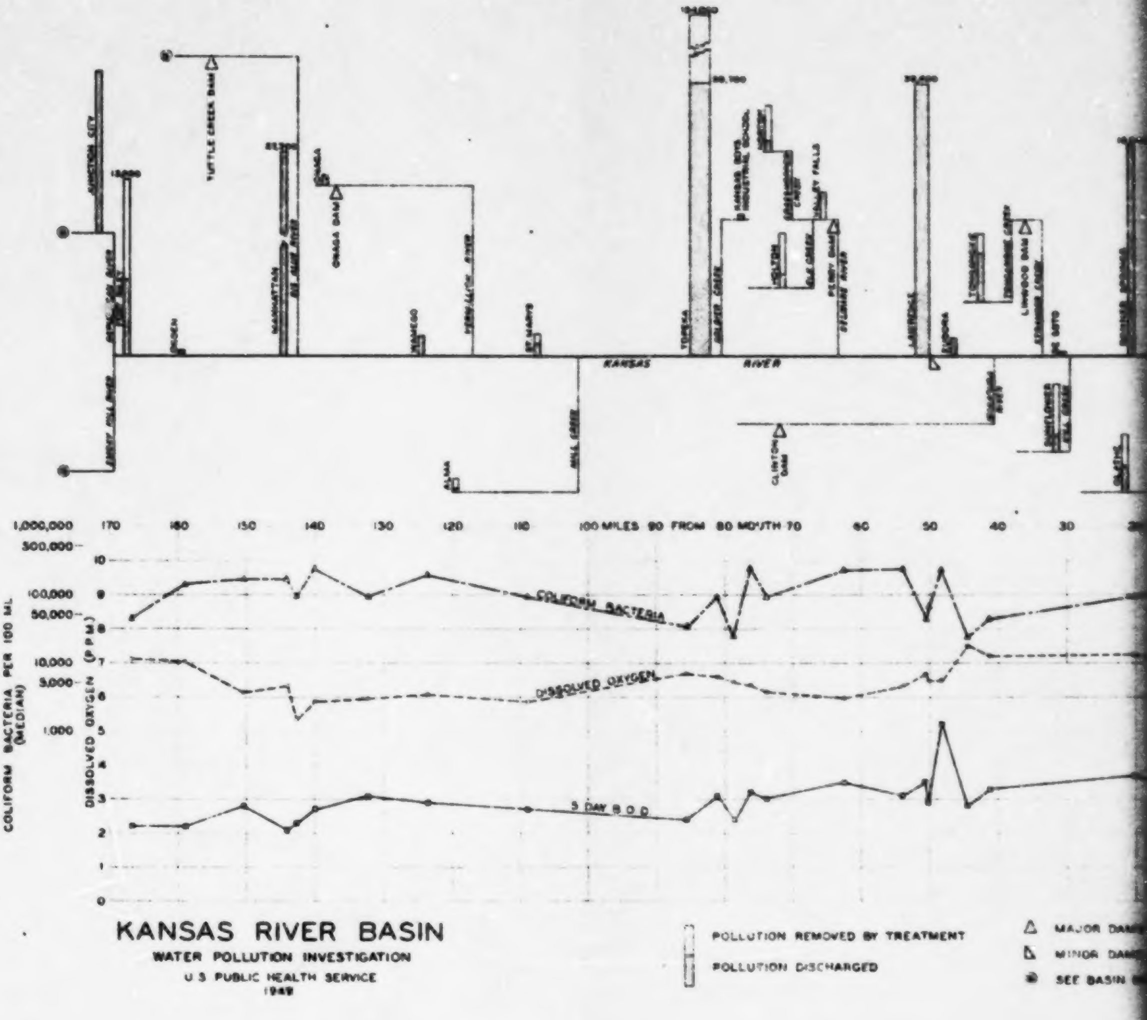
See the following pages for greater detail.

KANSAS RIVER

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON - 1948
(JUNE, JULY, AUG., SEPT.)

75-a

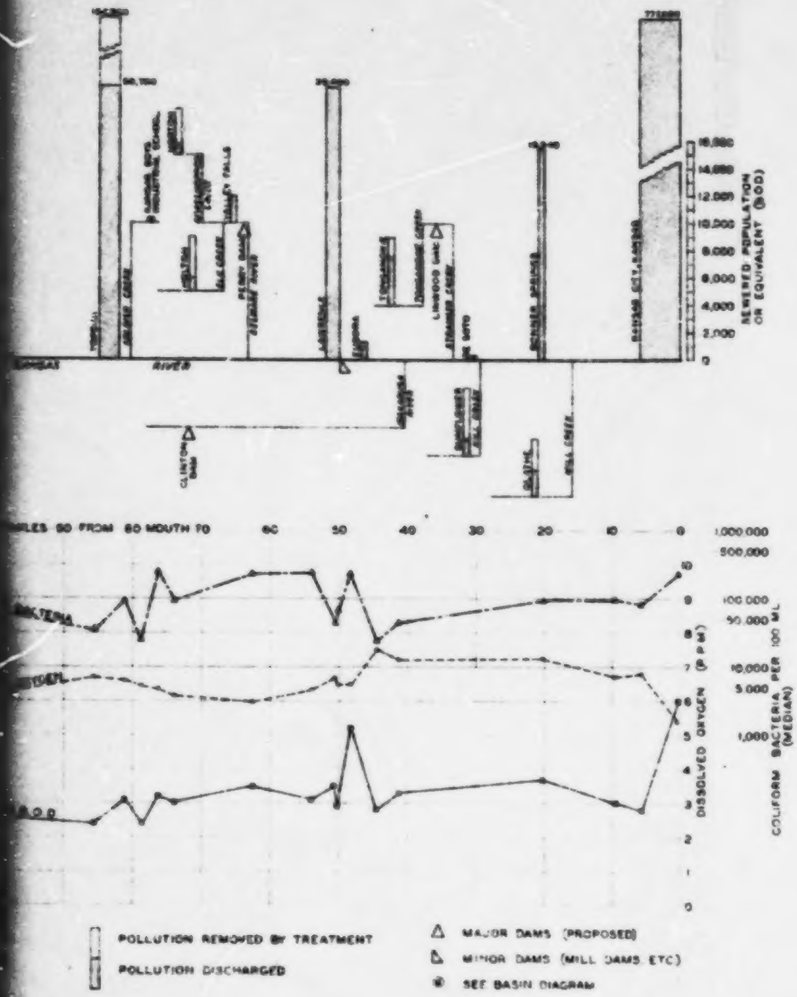


KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE
1949

A

FIG. K-1



KANSAS RIVER

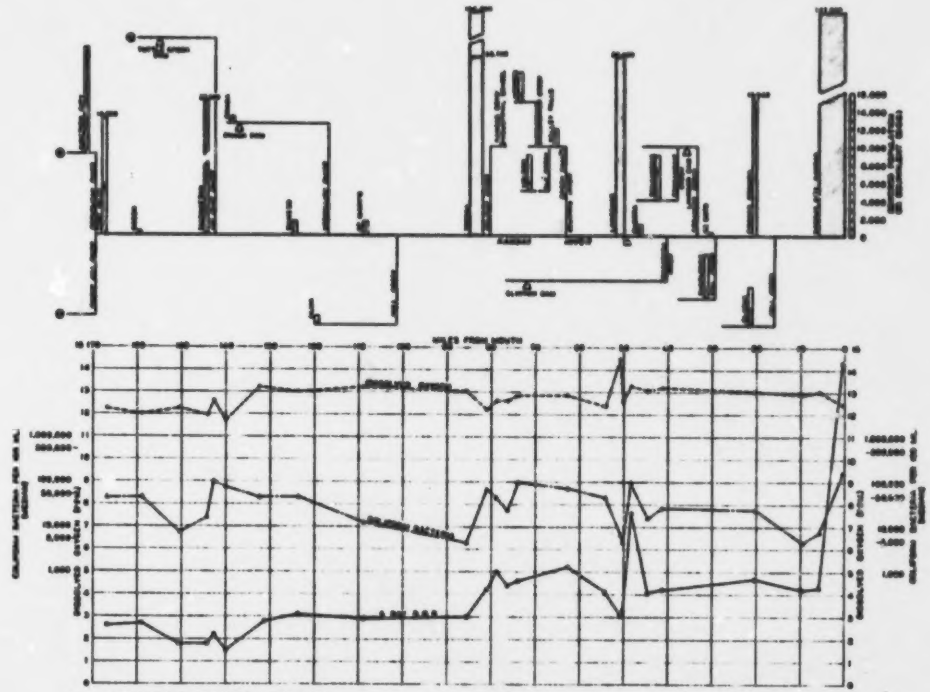
SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON-1948
(JUNE, JULY, AUG., SEPT.)

B

75-a

FIG. K-2



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U S PUBLIC HEALTH SERVICE
1948

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See the following pages
for greater detail.
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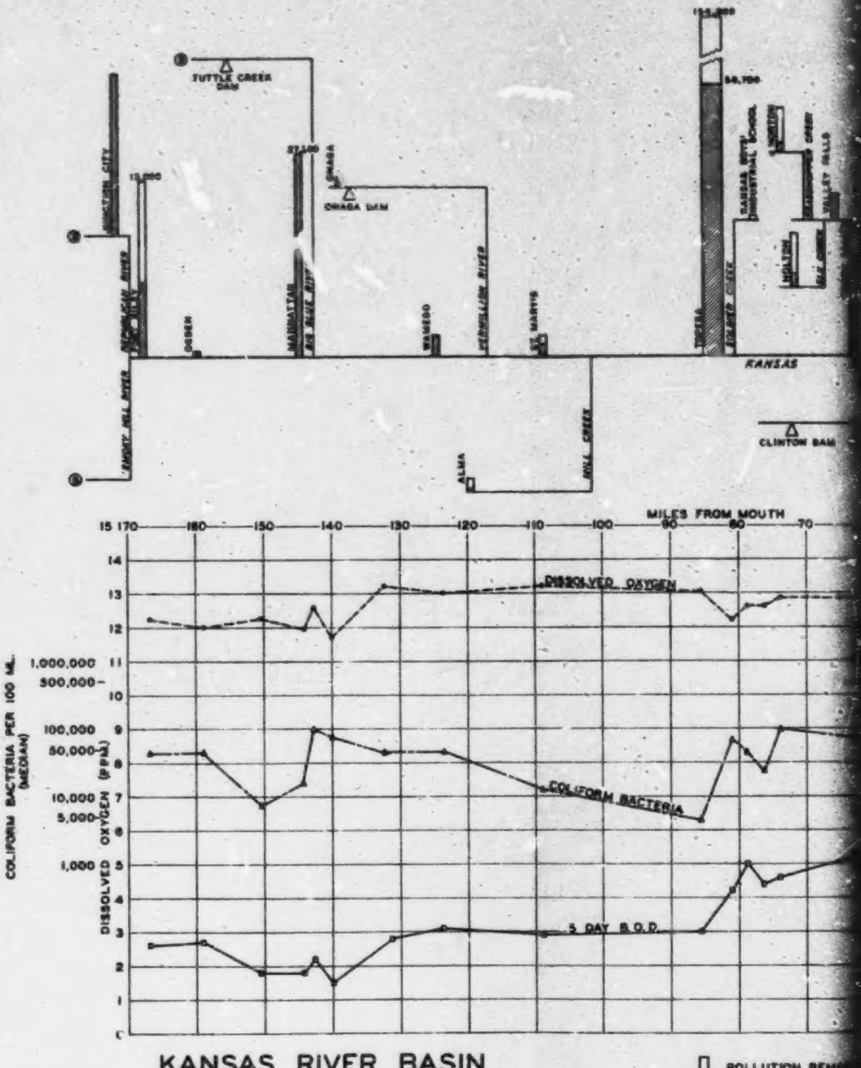
KANSAS RIVER

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

WINTER SEASON - 1947-1948
(DEC.-JAN.-FEB.)

75-7



KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE
1949

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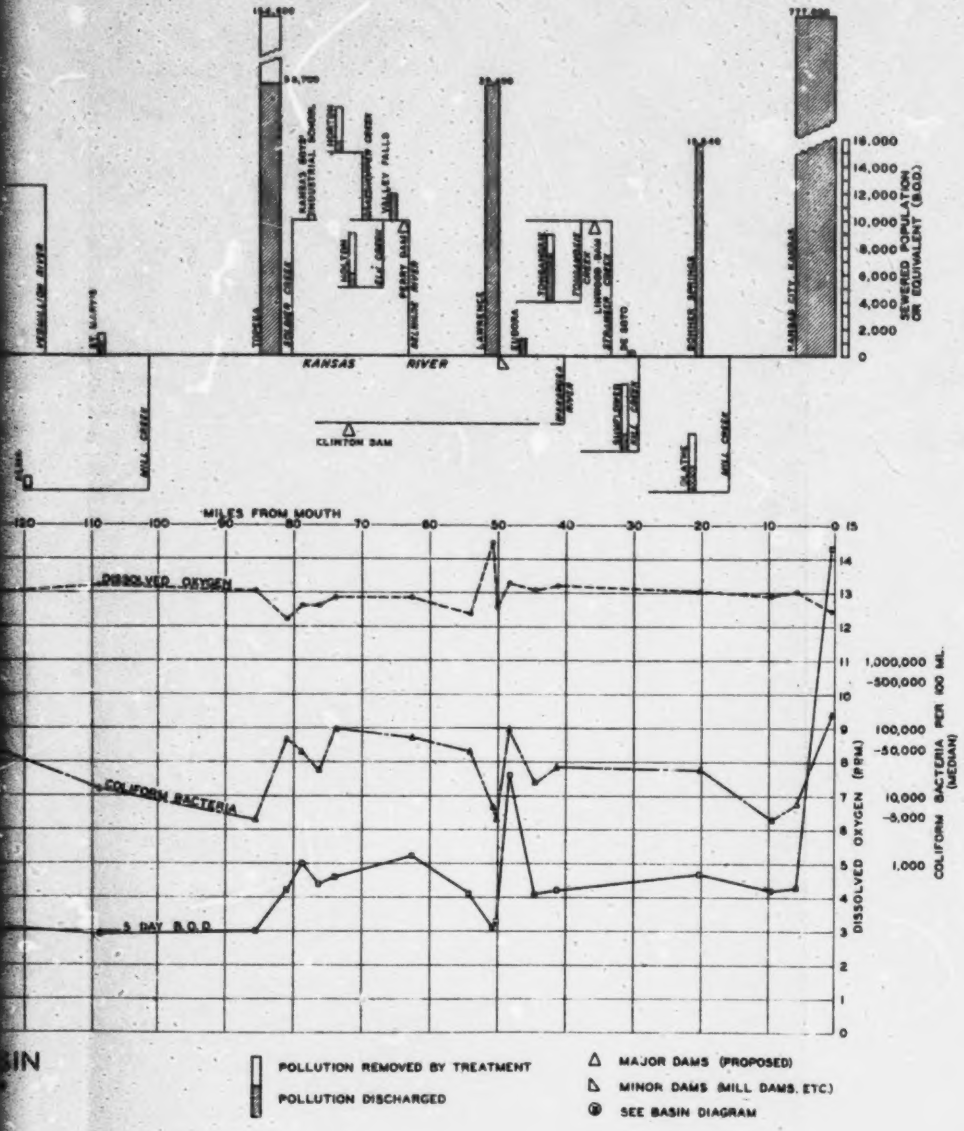
FIG. K-2



KANSAS RIVER

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

WINTER SEASON - 1947, 1948
(DEC., JAN., FEB.)

B

75-6

Average chloride values were generally less than the recommended limit of 250 ppm (Public Health Service Drinking Water Standards - 1946). However, as indicated on Figure 10, maxima in excess of this value were found in the upper Kansas River and Stranger Creek. Maxima in excess of 250 ppm have been noted at the Topeka and Lawrence municipal water plants prior to this survey. In general, chloride concentrations in the main stem vary approximately inversely with the discharge.

The mineral quality of the waters of the main stem of the Kansas River also varies considerably, depending upon whether the principal flow is from the Smoky Hill, Solomon and Saline Rivers, or from the Republican, Big Blue and Delaware Rivers.

Low-Flow Frequencies

A brief study has been made of the frequency of low monthly flows by months during the period of record, which varies from 16 to 17 years. Tables K-7 and K-8 summarize these results at 4 points on the main stem and at one point each on Stranger Creek, Wakarusa River, Delaware River and Soldier Creek.

In computing the low monthly flow frequency, the lowest monthly flow for each period of each year of record is used. Low flows were computed for summer (June to September, inclusive) and winter (December and January and February of the following year) periods.

Low summer flows are important because critical oxygen deficiencies can occur during periods of high stream temperatures. Low winter flows are of interest when irrigation usage of the storage is planned or when ice conditions may affect the reaeration capacity of the stream.

DISCUSSION

Sewage Treatment Status and Needs

Main Stem, Kansas River - Ogden, Manhattan, Wamego, Kansas State Institutions at Topeka, Lawrence, Eudora, De Soto, Bonner Springs and Kansas City, Kansas, all discharge raw sewage and organic industrial wastes into the waters of the Kansas River. Pollution loads from these cities are given in Table K-6. Minimum summer flows and distances between sources of pollution are fairly large but, despite these factors, a minimum of efficient primary waste treatment should be provided at these cities to prevent local nuisances and public health hazards. Plans for treatment of the raw sewage from the State Institutions at Topeka are under consideration.

Table K-7 Main Kansas River & Minor Tributaries

Frequency of Low Mean Monthly Summer (June - Sept) Discharges

Years of Record	Stream and Location	Miles to Mouth: Kansas River	Miles to Mouth: Tributary	Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in: 2 years	3 years	5 years	10 years	Minimum*
	Kansas River								
16	Bonner Springs, Kans	20.2		59,887	2,920	1,730	1,170	570	466
16	Topeka, Kans	82.3		56,710	2,500	1,420	1,070	470	276
16	Wamego, Kans	123.6		55,235	2,060	1,180	850	500	278
16	Ogden, Kans	158.9		45,237	1,230	900	500	270	163
	Stranger Creek	33.6							
17	Tonganoxie, Kans		17.1	411	10	6	2	0	0
	Wakarusa River	40.7							
17	Lawrence, Kans		13.3	420	7	0.4	0	0	0
	Delaware River	63.3							
16	Valley Falls, Kans		30.6	922	18	13	4	3	1
	Soldier Creek	80.2							
17	Topeka, Kans		3.5	286	6	2	0.4	0	0

Table K-8 Main Kansas River & Minor Tributaries

Frequency of Low Mean Monthly Winter (Dec - Feb) Discharges

Years of Record	Stream and Location	Miles to Mouth: Kansas River	Miles to Mouth: Tributary	Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in: 2 years	3 years	5 years	10 years	Minimum*
	Kansas River								
16	Bonner Springs, Kans	20.2		59,887	1,230	1,020	770	650	418
16	Topeka, Kans	82.3		56,710	1,670	825	650	560	342
16	Wamego, Kans	123.6		55,235	1,060	710	620	500	309
16	Ogden, Kans	158.9		45,237	590	490	350	290	119
	Stranger Creek	33.6							
17	Tonganoxie, Kans		17.1	411	9	5	3	2	0.5
	Wakarusa River	40.7							
17	Lawrence, Kans		13.3	420	3	1.5	0	0	0
	Delaware River	63.3							
16	Valley Falls, Kans		30.6	922	30	16	9	4	3
	Soldier Creek	80.2							
16	Topeka, Kans		3.5	286	7	4	1	0.2	0

* Low Mean Month

The B.O.D. results indicate a rather heavy pollution load below Lawrence, Kansas, and a very heavy one below Kansas City, Kansas. In this connection attention is called to the fact that some garbage from the city of Kansas City, Missouri, is washed into the Kansas River at this point. Floating garbage, oil, and coarse sewage solids, all indicative of gross pollution, were noted while sampling the Kansas River about one-third mile from its mouth near Kansas City, Kansas, and Kansas City, Missouri. A study of its sewage problem is now being conducted by Kansas City, Kansas. Treatment of sewage from this city should be planned on a metropolitan area basis and will require the construction of intercepting sewers as well as treatment facilities. Possibly a satisfactory answer to this problem would be the discharge of sewage after primary treatment to the Missouri River which has a higher normal summer season minimum flow than the Kansas River.

About twenty river miles below the raw sewage discharge from Lawrence, Kansas, there is located the intake for the largest water treatment plant in Kansas - the Sunflower Ordnance Works' filtration plant. This plant is not operating at present but if ordnance production on a large scale is ever resumed this plant will again be needed.

Topeka, Kansas, should continue its program aimed at a high degree of efficiency in plant operation. It is imperative that the "slugs" of pollution formerly discharged from this City's treatment plant be avoided because of hazards to the Lawrence public water supply. Topeka is also in need of more plant capacity and plans for this are under consideration.

St. Marys, Kansas, while credited with primary treatment is in need of improved sewage treatment works.

Tributaries, Main Stem - Valley Falls located at Mile 29.7 on the Delaware River, discharges wastes from an inoperative imhoff tank equivalent to a sewered population of 1,945. Local nuisances and health hazards may occur at times of summer minimum flows. This City needs secondary sewage treatment.

Holton (Elk Creek - mile 11.6) and Horton (Grasshopper Creek - mile 5.6), discharge secondary treatment plant effluents into small tributaries of the Delaware River equivalent to sewered populations of 1,000 and 840 respectively. As long as these plants are carefully maintained and operated pollution problems below these cities should be of only minor, local significance. Such problems may be expected during summer season periods when the flow in the small receiving streams is at a minimum.

Tonganoxie, Kansas (Mile 3.1, Tonganoxie Creek) and an industry located near the City discharge organic wastes equivalent to a sewered population of about 3,580. The principal portion of this pollution load is organic industrial wastes derived from milk processing. The City has a secondary treatment plant. Serious pollution problems have occurred on this stream in the past and the Kansas State Board of Health has taken action to cause abatement of the pollution. A treatment plant for the industrial wastes is being planned and may be under construction by the time this report is released.

Alma located on Mill Creek which enters the Main Stem at Mile 101.5 and Onaga on the Vermillion River both have secondary treatment plants which if properly maintained and operated should reduce the pollution load from these cities at least 75%. However, the Onaga plant is not functioning efficiently and a pollution problem of local significance exists below this city at times of minimum summer flow. Although the Alma sewage plant provides a 75% reduction in the pollution load, a similar problem exists below this city during summer low flow periods when the majority or all of the stream flow is treated sewage.

Olathe, Kansas, located at Mile 12.0 on another Mill Creek which enters the Main Stem at Mile 16.0, has a secondary treatment plant which, while not operating at high efficiency, does provide a substantial reduction in the pollution load. Pollution problems of local significance occur below Olathe during summer season low stream flow periods when most or all of the creek flow below the City is partially treated sewage.

A similar situation exists below Sunflower, Kansas, located at Mile 2.0 on Kill Creek. Here, however, the treatment efficiency is higher.

A large industrial plant located on Soldier Creek near Topeka provides secondary treatment for its sewage. A nearby State institution discharges raw sewage into the creek. The latter should provide secondary treatment and plans have been started to accomplish this.

Desirable Flows

Flows classed as "Desirable" from the standpoint of oxygen relations in the stream are given in the following table as are flows necessary to prevent damage to various cities. The introductory section of this report contains an explanation of the derivation of these flows.

Table K-9 - Main Kansas River and Minor Tributaries - Desirable Flows

Place	Normal Expected Flow, cfs	Useful Desirable Flow, cfs*	Flow to Prevent Damage to City, cfs
Manhattan	550	225	225
Topeka	1,070	500	500
Lawrence	1,100	375	375

*After a minimum of primary sewage treatment
Note: All flows are minimum monthly mean values.

On the basis of a minimum of primary treatment at all cities along the main stem, these minimum monthly mean flows should be sufficient during the summer season to prevent oxygen levels falling below 5 ppm. These flow estimates consider only oxygen relationships and take no account of other important water quality factors. Inasmuch as these flows are less than the normal minima, no tangible monetary pollution control benefits are assignable to summer regulation by upstream reservoirs.

Flow needs for the maintenance of an adequate reserve of dissolved oxygen (5 ppm) vary with temperature. Table K-10 indicates the relationship between desirable summer season mean monthly minimum flows and flows during other months when water temperatures are lower.

Table K-10 - Main Kansas River and Minor Tributaries
Seasonal Variations of Desirable
Minimum Monthly Mean Flow

Month	Water Temperature °F	°C	Minimum Monthly Mean Desirable Flow as % of Similar Summer Season Flow
January	34	1	20
February	34	1	20
March	37	3	25
April	54	12	40
May	66	19	60
June	72	22	100
July	81	27	100
August	79	26	100
September	75	24	100
October	59	15	45
November	48	9	30
December	36	2	20

Water Supply Problems

Ground Water - Ground water is plentiful particularly in the main river valley and is used as a reliable source of supply by several cities. Considerable industrial use is made of this valuable water resource in the Kansas City, Kansas metropolitan area. However, in some sections of the Kansas River Basin the quantity of ground water is limited. For example, Holton, Kansas, which for many years made use of the limited ground water in the vicinity of the city, has recently found it necessary to develop a surface water supply. Valley Falls has also suffered water shortages and has considered the installation of a surface water supply. There is a possibility that areas near Kansas City, Kansas, but outside the Kansas River Basin, will eventually make use of the ground water resources of the Basin.

Bacterial Quality - Cities using impounded supplies on tributary streams obtain water of fairly good bacterial quality as lack of pollution above the impoundment and the natural die-away which occurs in storage reservoirs result in fairly low coliform indices for these supplies. Water purification plants serving these cities, if suitably designed, maintained and operated, have no difficulty producing a water of acceptable bacterial quality.

The Topeka and Lawrence water plants which treat water from the main stem have to cope with a very high coliform bacteria loading. This results from sewage pollution and surface wash. Fortunately, the softening and filtration plants at these cities are modern and well operated. Both practice free residual prechlorination, as well as coagulation, excess lime softening, filtration and post chlorination. Consequently, these plants, insofar as their own and health department tests show, have been able consistently to produce bacteriologically safe drinking water despite coliform indices at their intakes well in excess of 50,000 M.P.N. per 100 ml.

Coliform bacteria numbers vary with the turbidity and stage of the stream. The latter two factors are, of course, closely related. In general high stages and the corresponding high turbidities on the main stem result in high coliform indices. This when viewed in the light of the fairly low B.O.D. values above Lawrence and Topeka lends support to the belief that the high coliform numbers are not entirely caused by sewage pollution. However, tests conducted by the Kansas State Board of Health Laboratory showed median concentrations of sewage streptocci which very closely paralleled the median coliform concentrations in the Kansas River shown in this report. While undoubtedly sewage pollution does contribute material numbers, evidently many are derived from surface water runoff from farms and cities. From a sanitary standpoint bacterial contamination from these sources may have less significance although its health aspects cannot be ignored. This same situation was noted in the 1922 Survey of the Kansas River and its Tributaries conducted by the Kansas State Board of Health. During this survey the coliform index above Topeka was 7,000 per 100 ml. (Phelps Index--not the same as the MPN value used in this report) during high stream stages and only 500 per 100 ml. following a six weeks' dry period. Similarly, results at Lawrence were 40,000 per 100 ml. during high stages and only 10,000 per 100 ml. following the dry period.

Mineral Quality - In general, the surface water mineral quality of the Main Kansas River Basin is good. Fairly soft surface supplies have been developed by impoundment of tributaries of the Kansas River. The principal mineral problems along the main stem are those of high chloride and hardness which usually occur during low runoff periods. Both Topeka and Lawrence routinely soften their supplies to hardness values of about 100 ppm. Chloride cannot be removed by conventional treatment methods. Excessive chloride values have been noted at both Lawrence and Topeka. Chloride concentration varies approximately inversely with the river discharge; at high flows the chloride will be rather low and at low flows, fairly high. Maximum values well in excess of 200 ppm were found during this survey and even higher values have been noted in the past at Topeka and Lawrence. The maximum recommended chloride concentration is 250 ppm (Public Health Service Drinking Water Standards, 1946). The mineral quality of the main stem water is also subject to variation caused by the widely varying chloride concentrations found in the principal tributaries at their confluence at Junction City, Kansas. The Smoky Hill carries a high and fairly constant chloride load (lbs/sec.) while the Republican waters contain much less. This fact must be carefully considered if there is to be any sharp flow reduction in the main river as a result of irrigation water use. If this reduction occurs as a result of decreased discharge from the Republican River, chloride and other mineral constituents in the main stem may rise to objectionable heights resulting in serious damage to the water supplies of the cities of Lawrence and Topeka. This problem is also discussed in the Republican River Section of this report.

The high chloride values found in Stranger Creek are apparently due to brine pollution from abandoned gas wells.

Other Water Quality Problems

One of the principal water quality problems at most of the surface water supplies in the Main Kansas Basin is that associated with tastes and odors. This has always been a particularly vexing problem at Topeka and Lawrence and these cities have tried various methods of control, none of which have proved entirely satisfactory in every respect. The Main Kansas River is classed as a "flashy" stream by water works men. Their meaning is that the quality varies substantially and rapidly and renders treatment difficult. Serious taste and odor problems are usually associated with a slight flow increase or with a prolonged low stage period. During the latter periods algae growth in the Kansas River have in the fairly recent past rendered the water quite objectionable from a taste standpoint even after the most extensive treatment for taste and odor removal. Reservoir releases during low flow periods, while having a beneficial effect on mineral quality, may have an adverse one on taste and odor if the reservoir water itself has, at the time of release or had just prior to release, a luxuriant growth of taste and odor producing organisms (algae). This general question is discussed in the introductory section of this report.

BIG BLUE RIVER BASIN

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BIG BLUE RIVER BASIN

SYLLABUS

The Big Blue River rises in southeastern Nebraska and flows generally southward to form a junction with the Kansas River below Manhattan, Kansas. The economy of the basin is dependent upon agriculture and the processing of farm products. Three cities secure public water supplies from surface sources with Marysville, Kansas, being the only one located on the main stem of the Big Blue River; the remainder utilize ground sources. The pollution load in this basin is relatively small and the principal stream sanitation problems are of local significance on streams where summer low flows approach zero. Tuttle Creek is the only dam authorized in this basin and is located on the Big Blue River near its mouth. Backwater from the dam may at times affect public water supply and the sewage discharge at Marysville, Kansas.

CONCLUSIONS

(1) There are three municipalities in the Big Blue River Basin that obtain public water supplies from surface sources. They furnish a total population of 6,350 with an average of 0.85 million gallons per day. Since these are all located above the authorized Tuttle Creek dam site, flow conditions below the reservoir will not influence these supplies. The pool may back up to the Marysville water intake and sewer outlet, thereby creating a special problem. Diversion from this reservoir may have beneficial effect on the surface water supplies at Topeka and Lawrence.

(2) There are 93 cities obtaining public water supplies from ground sources serving a total population of 104,345 with an average of 16.79 million gallons per day.

(3) Sewage from a population of 86,940 and industrial wastes with a sewered population equivalent of 40,235 or a total of 127,175 are discharged into the Big Blue River and its tributaries. Existing treatment works should reduce this load to 73,975 or a 42 per cent reduction. Sixty-four per cent of the sewered population is provided with sewage treatment facilities.

(4) In general, the pollution load in this basin is not great. This statement is supported, in general, by the laboratory and pollution data shown in Figures B-1 and B-2.

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(5) The 14 communities in the basin now discharging raw sewage should provide at least primary treatment to prevent local nuisances and health hazards. Depending upon the local situation, a higher degree of treatment may be required, particularly on the minor tributaries.

(6) There is no pollution of consequence below Tuttle Creek Reservoir on the Big Blue River. Supplemental low flows from this reservoir could be used to improve stream conditions in the Kansas River at and below Topeka and Lawrence. However, discharges from reservoirs in other river basins could be utilized for these purposes.

(7) The City of Marysville, Kansas may be adversely affected by the Tuttle Creek Reservoir if the final design at the reservoir is such that backwater produces a pooling effect in the Big Blue River to Marysville or above. If this is the case, special provisions will be necessary at the water works intake and the city sewer outlet, as pooling of the river might subject the water supply to pollution from Marysville's sewers.

RESERVOIR PROJECTS

Table B-1 presents summarized information obtained from the Corps of Engineers on the authorized Tuttle Creek Reservoir in the Big Blue River Drainage Basin. This is the only reservoir in the Big Blue Basin, but its drainage area is equal to 99.6 per cent of the total.

DESCRIPTION

The Big Blue River extends about 285 miles from its headwaters in the northeastern part of Hamilton County, located in the southeastern part of Nebraska, to its juncture with the Kansas River at Manhattan, Kansas. The principal tributaries of interest in connection with this survey are listed in Table B-2.

Table B-1 Big Blue River Basin - Reservoir Data (1)

Reservoir	Tributary Stream	Miles to Mouth		Storage, Acre-Feet				Area Max. Pool Acres	Status
		Big Blue River	Tributary Stream	Silt and Conservation	Irrigation	Flood Control	Total		
Tuttle Creek	Big Blue	12.3		680,000	0	1,600,000	2,280,000	53,500	Authorized

(1) Data from Corps of Engineers

Table B-2 - Big Blue River Basin - Principal Tributaries

Tributary	Miles above Big Blue River Mouth	Drainage Area, Square Miles
Black Vermillion River	48.1	510
Little Blue River	61.8	3,497
Big Indian Creek	110.4	205
Turkey Creek	150.8	786
W. Fork Big Blue River	192.1	1,259
Lincoln Creek	225.5	446

The lower 95 miles of the Big Blue River are in Kansas and the balance, about 190 miles, is in Nebraska. There are 9,600 square miles of drainage area in the Big Blue River Basin, consisting of 2,384 square miles in Kansas and 7,216 square miles in Nebraska.

Table B-3 lists 107 cities in the Big Blue River Basin. The four towns having populations (U. S. Census 1940) over 5,000 are as follows: Nebraska - Beatrice 10,883; Fairbury 6,304; Hastings 15,145; and, York 5,383. Most of the towns are small, as evidenced by the fact that 85 of the 107 have populations less than 1,000. The 1948 population estimates indicate that with the exception of a few of the larger cities there has been no marked change in population during 1940-48.

The predominant activity in the Basin is agriculture, most of the area being devoted to production of grain.

The Big Blue River Basin lies in a relatively humid section of the Kansas River watershed, with average annual rainfall varying from slightly less than 25 inches in the western end to 32 inches in the eastern end. The average annual rainfall for the entire basin is about 29 inches.

PRESENTATION OF DATA

Public Water Supplies

Information contained in Table B-4 indicates that three municipalities obtain public water supplies from surface sources. These are Washington and Marysville, Kansas, and Nelson, Nebraska which

Table B-3

Big Blue River Basin

Population of Cities

City	Population - U. S. Census			
	1920	1930	1940	1948*
Axtell, Kansas	617	607	545	503
Barnes, Kansas	395	361	391	327
Beattie, Kansas	452	434	389	340
Blue Rapids, Kansas	1,534	1,465	1,433	1,525
Centralia, Kansas	619	682	607	568
Circleville, Kansas	226	211	216	172
Delia, Kansas	244	269	222	175
Frankfort, Kansas	1,314	1,346	1,243	1,262
Greenleaf, Kansas	778	660	739	687
Haddam, Kansas	392	381	384	388
Hanover, Kansas	947	880	896	855
Hollenburg, Kansas	-	-	128	96
Irving, Kansas	341	356	310	316
Leonardville, Kansas	325	392	342	309
Mahaska, Kansas	210	218	195	206
Marysville, Kansas	3,048	4,013	4,055	4,174
Mayetta, Kansas	309	294	275	227
Morrowville, Kansas	-	246	308	221
Munden, Kansas	339	205	193	175
Narka, Kansas	207	252	193	192
Netawaka, Kansas	267	229	226	213
Oketo, Kansas	228	225	218	194
Randolph, Kansas	401	408	369	388
Soldier, Kansas	346	274	247	212
Vermillion, Kansas	294	288	300	277
Washington, Kansas	1,406	1,370	1,598	1,429
Waterville, Kansas	665	698	717	688
Whiting, Kansas	433	351	343	284
Alexandria, Nebraska	432	421	369	-
Aurora, Nebraska	2,962	2,715	2,419	-
Axtell, Nebraska	385	328	295	350
Barneston, Nebraska	258	221	219	-
Beatrice, Nebraska	9,664	10,297	10,883	12,500
Beaver Crossing, Nebraska	543	522	550	500
Belvidere, Nebraska	424	358	325	-
Benedict, Nebraska	313	279	221	-
Bladen, Nebraska	445	448	272	-
Blue Hill, Nebraska	726	669	565	-
Blue Springs, Nebraska	742	700	681	-
Bradshaw, Nebraska	391	340	339	-
Bruning, Nebraska	326	316	232	-
Campbell, Nebraska	561	565	478	-
Carleton, Nebraska	350	363	350	-
Chester, Nebraska	529	579	634	-
Clay Center, Nebraska	965	933	715	-
Cortland, Nebraska	322	318	307	-
Crete, Nebraska	2,445	2,865	3,038	3,500
Davenport, Nebraska	495	477	450	-
David City, Nebraska	2,216	2,333	2,272	-
Deshler, Nebraska	944	1,177	1,037	1,220
Diller, Nebraska	418	405	378	-
De Witt, Nebraska	623	534	490	-
Dorchester, Nebraska	522	579	558	565
Edgar, Nebraska	996	987	708	-
Endicott, Nebraska	197	243	246	-
Exeter, Nebraska	910	941	841	-

Table B-3

Big Blue River Basin

Population of Cities (continued)

City	Population - U. S. Census			
	1920	1930	1940	1948*
Fairbury, Nebraska	5,454	6,192	6,304	8,000
Fairfield, Nebraska	784	757	640	525
Fairmont, Nebraska	785	740	810	-
Friend, Nebraska	1,263	1,214	1,169	-
Geneva, Nebraska	1,768	1,662	1,888	2,000
Giltner, Nebraska	387	355	325	-
Glenville, Nebraska	400	376	285	-
Grafton, Nebraska	324	284	240	-
Gresham, Nebraska	492	442	352	-
Hampton, Nebraska	457	369	310	-
Harvard, Nebraska	991	865	704	-
Hastings, Nebraska	11,647	15,490	15,145	-
Hebron, Nebraska	1,513	1,804	1,909	2,000
Henderson, Nebraska	485	480	495	497
Holstein, Nebraska	227	254	241	-
Hubbell, Nebraska	231	233	250	-
Jansen, Nebraska	258	264	255	-
Juniata, Nebraska	329	367	338	410
Kenesaw, Nebraska	646	614	551	610
Lawrence, Nebraska	538	528	445	-
Liberty, Nebraska	375	348	340	-
McCool Junction, Nebraska	338	356	272	-
Milford, Nebraska	792	832	759	1,279
Milligan, Nebraska	418	412	392	-
Minden, Nebraska	1,527	1,716	1,848	-
Nelson, Nebraska	955	903	963	-
Odell, Nebraska	403	472	404	-
Ohiowa, Nebraska	433	394	326	-
Osceola, Nebraska	1,209	1,054	1,039	-
Plymouth, Nebraska	453	418	434	-
Polk, Nebraska	561	532	493	500
Reynolds, Nebraska	208	213	211	-
Rising City, Nebraska	460	472	420	-
Ruskin, Nebraska	360	239	223	205
Seward, Nebraska	2,368	2,737	2,826	3,200
Shelby, Nebraska	559	630	627	-
Shickley, Nebraska	396	389	342	-
Staplehurst, Nebraska	235	254	234	-
Steele City, Nebraska	300	295	291	-
Stromsburg, Nebraska	1,361	1,320	1,127	1,238
Surprise, Nebraska	279	257	228	-
Sutton, Nebraska	1,603	1,540	1,403	-
Swanton, Nebraska	276	238	233	-
Tobias, Nebraska	357	402	316	-
Ulysses, Nebraska	460	492	429	-
Utica, Nebraska	571	566	539	-
Waco, Nebraska	297	266	203	-
Western, Nebraska	427	511	437	-
Wilber, Nebraska	1,255	1,352	1,355	-
Wymore, Nebraska	2,592	2,680	2,457	3,000
York, Nebraska	5,388	5,712	5,383	6,500

* Estimated

Kansas populations from Kansas State Board of Agriculture Bulletin "Population of Kansas" August 24, 1948.

provide 0.85 million gallons per day to serve a total population of 6,350. In addition, flow conditions on the Big Blue River may have some influence on the public water supplies of Topeka and Lawrence, Kansas. The combined demand of these downstream cities on the Kansas River is approximately 8.83 million gallons per day, serving a total population of 113,900. There is also considerable industrial use of water from the Main Kansas River below Manhattan.

Table B-4 - Big Blue River Basin - Municipal Surface Water Supplies

Stream and Municipality	State	Miles above Mouth		Treatment (1)	Population Served	Average Consumption M.G.D.
		Big Blue River	Tributary			
Big Blue River						
Little Blue River		61.8				
Mill Creek			30.9			
Washington	Kans		22.3	HFD	1,500	0.10
Elk Creek			116.0			
Nelson	Nebr		10.0	FD	850	0.10
Marysville	Kans	80.0		HFD	4,000	0.65
Total					6,350	0.85

(1) F - Coagulated, settled, filtered
H - Softened
D - Chlorinated

There are 93 cities obtaining public water supplies from ground water sources, as shown in Table B-5. These supplies serve a population of 104,345, with a total average consumption of 16.79 million gallons per day. Since it is reported (Quality of Water Supplies of Kansas, Water Supply Paper 273, U.S. G.S.) that wells in certain strata of some sections of the Big Blue are saline, it is possible that some of these cities now using ground water supplies may need to develop surface water supplies in the future.

Sources of Pollution

Table B-6 summarizes the location and magnitude of significant sources of organic pollution, including the latest available data on industrial wastes discharged to streams in the Big Blue River Basin. According to this table, the population connected to sewers is 86,940. The industrial waste data indicate an additional organic pollution load from industrial wastes equal to a sewered population

Table B-5

Big Blue River Basin

Municipal Water Supplies From Ground Sources

Municipality	State	Source (1)	Treat-ment (2)	Population Served	Average Consumption M. G. D.
Axtell	Kans	SW	N	490	0.06
Barnes	Kans	DW	N	280	0.02
Beattie	Kans	SW	D	280	0.01
Blue Rapids	Kans	SW	D	1,250	0.10
Centralia	Kans	SW	N	460	0.02
Frankfort	Kans	DW	D	1,250	0.14
Greenleaf	Kans	SW	D	610	0.07
Haddam	Kans	SW	D	370	0.02
Hanover	Kans	SW	HP	600	0.05
Irving	Kans	SW	N	280	0.01
Leonardville	Kans	DW	N	280	0.03
Mahaska	Kans	DW	N	190	0.01
Morrowville	Kans	SW	N	210	0.01
Munden	Kans	SW	N	140	0.01
Narka	Kans	DW	N	160	0.01
Oketo	Kans	SW	N	130	0.01
Randolph	Kans	SW	N	350	0.02
Vermillion	Kans	SW	D	110	0.01
Waterville	Kans	SW	N	650	0.03
Alexandria	Nebr	W	N	350	0.03
Aurora	Nebr	DW	N	2,400	0.09
Axtell	Nebr	DW	N	250	0.03
Beatrice	Nebr	W	N	10,000	1.60
Beatrice State Home	Nebr	W	N	2,000	0.20
Beaver Crossing	Nebr	DW	N	330	0.10
Belvidere	Nebr	W	N	260	0.06
Benedict	Nebr	DW	N	200	0.03
Bladen	Nebr	DW	N	280	0.08
Blue Hill	Nebr	DW	N	500	0.04
Blue Springs	Nebr	Wymore	N	650	0.05
Bradshaw	Nebr	DW	N	270	0.02
Gruning	Nebr	W	N	185	0.02
Burchard	Nebr	W	N	160	0.02
Campbell	Nebr	DW	N	400	0.20
Carleton	Nebr	W	N	300	0.10
Chester	Nebr	W	N	580	0.40
Clatonia	Nebr	DW	N	150	0.02
Clay Center	Nebr	W	N	830	0.30
Cortland	Nebr	DW	N	250	0.02
Crete	Nebr	DW	N	2,500	2.00
Davenport	Nebr	W	N	390	0.03
David City	Nebr	DW	N	2,600	0.40
Deshler	Nebr	DW	N	1,200	0.10
De Witt	Nebr	W	N	430	0.05
Diller	Nebr	W	N	320	0.04
Dorchester	Nebr	DW	N	575	0.15
Edgar	Nebr	DW	N	800	0.15
Exeter	Nebr	W	N	800	0.10
Fairbury	Nebr	SP,SW	HD	6,000	1.00
Fairfield	Nebr	W	N	525	0.18
Fairmont	Nebr	DW	N	800	0.25
Friend	Nebr	DW	N	1,000	0.20
Geneva	Nebr	W	N	1,700	0.40
Giltner	Nebr	DW	N	230	0.02
Glenville	Nebr	DW	N	250	0.03
Grafton	Nebr	DW	N	170	0.015

Table B-5

Big Blue River Basin

Municipal Water Supplies From Ground Sources (continued)

Municipality	State	Source (1)	Treatment (2)	Population Served	Average Consumption M. G. D.
Gresham	Nebr	DW	N	300	0.09
Hampton	Nebr	DW	N	280	0.03
Harvard	Nebr	DW	N	1,460	0.10
Hastings	Nebr	DW	N	21,000	4.00
Hebron	Nebr	DW	N	2,000	0.15
Henderson	Nebr	DW	N	370	0.02
Hubbell	Nebr	W	N	200	0.02
Ingleside	Nebr	W	N	2,000	0.20
Jansen	Nebr	DW	N	165	0.005
Kenesaw	Nebr	DW	N	500	0.10
Lawrence	Nebr	SW	N	560	0.06
Liberty	Nebr	W	N	170	0.01
Milford	Nebr	W	N	1,200	0.10
Milligan	Nebr	DW	N	330	0.025
Minden	Nebr	DW	N	1,600	0.10
Odell	Nebr	W	N	300	0.009
Ohiowa	Nebr	W	N	280	0.01
Osceola	Nebr	DW	N	950	0.20
Plymouth	Nebr	DW	N	350	0.008
Polk	Nebr	DW	N	400	0.01
Rising City	Nebr	DW	N	340	0.015
Seward	Nebr	W	N	2,900	0.20
Shelby	Nebr	DW	N	500	0.05
Shickley	Nebr	DW	N	300	0.02
Staplehurst	Nebr	W	N	200	0.05
Stromsburg	Nebr	W	HF	1,350	0.20
Sutton	Nebr	W	N	1,300	0.10
Swanton	Nebr	W	N	180	0.015
Tobias	Nebr	W	N	300	0.015
Trumbull	Nebr	DW	N	100	0.007
Ulysses	Nebr	W	N	425	0.06
Utica	Nebr	DW	N	500	0.04
Waco	Nebr	DW	N	200	0.025
Western	Nebr	DW	N	400	0.04
Wilbur	Nebr	W	N	1,250	0.17
Wymore	Nebr	W	N	3,000	0.90
York	Nebr	W	N	6,200	0.60
Total				104,345	16.789

(1) Source -
W - Wells
SW - Shallow Wells
DW - Deep Wells
SP - Springs

(2) Treatment -
N - None
F - Coagulated, Settled, Filtered
D - Chlorinated
H - Softened

Table B-6

Big Blue River Basin

Sources of Pollution Including Industrial Wastes Expressed as Sewered Population Equivalent (B.O.D.)

Municipality	State	Miles Above Mouth		Population Connected to Sewers	Treatment (1)	Sewered Population Equivalent (B.O.D.)	
		Big Blue River	Tributary			Untreated	Discharged
Big Blue River							
Black Vermillion River		48.1					
Frankfort	Kans		12.0	1,000	N	1,800	1,800
Nameless Creek			24.4				
Axtell	Kans		16.3	485	S	485	120
Blue Rapids	Kans	59.5		1,220	N	2,160	1,600
Little Blue River		61.8					
Waterville	Kans		6.2	680	N	1,080	1,080
Hanover	Kans		26.4	800	N	1,125	1,000
Mill Creek			30.9				
Washington	Kans		22.3	1,480	S	1,710	430
Rose Creek			50.0				
Chester	Nebr		32.0	280	S	280	80
Fairbury	Nebr		55.4	7,200	N	15,700	15,700
Big Sandy Creek			68.1				
Dry Sandy Creek			11.0				
Bruning	Nebr		14.0	120	S	120	25
Little Sandy Creek			39.0				
Clay Center	Nebr		30.0	800	S	800	240
Davenport	Nebr		40.0	250	S	250	75
Edgar	Nebr		49.0	800	S	800	200
Spring Creek			88.8				
Deshler	Nebr		9.6	1,200	S	1,200	380
Hebron	Nebr		89.6	2,000	N	2,800	2,800
Elk Creek			116.0				
Nelson	Nebr		9.4	750	N	750	750
Dry Creek			133.4				
Lawrence	Nebr		7.0	225	S	225	25
Pawnee Creek			138.9				
Ingleside	Nebr		27.0	2,000	S	2,000	500
Thirty-two Mile			152.0				
Kenesaw	Nebr		25.0	225	S	225	70
Ayr	Nebr		156.0	-	N	1,140	1,140
Blue Hill	Nebr		169.0	400	S	400	100
Minden	Nebr		195.0	1,200	S	1,200	390
Marysville	Kans	80.0		4,000	N	6,950	6,950
Big Indian Creek		110.4					
Jansen	Nebr		35.0	160	S	160	30
Wymore	Nebr	110.7		2,700	S	2,70p	800
Beatrice	Nebr	130.0		8,000	N	13,200	13,200
State Home at Beatrice	Nebr	130.0		2,000	S	2,000	300
Turkey Creek		150.3					
De Witt	Nebr		4.2	400	S	400	100
Friend	Nebr		46.0	1,000	S	1,000	200
Geneva	Nebr		58.0	1,000	S	1,000	300
Wilber	Nebr	167.1		850	N	850	850
Swan Creek		176.8					
Dorchester	Nebr		11.6	575	S	575	170
Crete	Nebr	180.8		3,500	S	8,500	2,550
West Fork Big Blue River		192.1					
Johnson Creek			11.7				
Exeter	Nebr		25.0	550	S	550	140
Beaver Crossing	Nebr		29.0	300	S	300	75
Indian Creek			29.6				
Fairmont	Nebr		28.0	750	S	75C	110
Beaver Creek			34.1				
York	Nebr		19.5	6,000	S	9,900	4,850
South Branch West Fork Blue			34.1				
School Creek			33.0				
Sutton	Nebr		7.0	1,000	S	1,000	200
Harvard	Nebr		26.0	600	S	600	90
Hastings	Nebr		76.7	20,000	S	25,700	6,400
Milford	Nebr	204.0		1,000	N	1,000	1,000
Seward	Nebr	225.3		2,800	N	3,800	3,800
Lincoln Creek		225.5					
Aurora	Nebr		73.0	2,000	S	5,400	1,600
Staplehurst	Nebr	236.0		200	P	200	150
North Branch Big Blue		247.3					
Shelby	Nebr		18.0	350	S	350	175
Davis Creek			22.4				
Osceola	Nebr		5.0	950	S	950	300
Stromsburg	Nebr		29.5	1,000	N	1,000	1,000
North Fork Big Blue River		247.3					
Keysor Creek			16.6				
David City	Nebr		6.8	2,400	S	2,500	800
Total				86,940		127,175	73,975

(1) Treatment -
N - None
P - Primary
S - Secondary

equivalent before treatment of 40,235. The total pollution load of 127,175 is reduced to 73,975 sewered population equivalent by treatment in municipal sewage treatment plants, or a reduction of 42 per cent.

Of equal significance is the proportion of sewage discharged untreated into the streams. Even though treated sewage still has an oxygen demand, this demand may be met by the stream to aid in alleviating stream pollution. However, even with excess oxygen-supplying capacity in a stream, the discharge of untreated sewage presents a major pollution problem. Fourteen of the 47 sewered municipalities in the Big Blue River Basin, having a sewered population equivalent of 52,975 discharge untreated sewage. This represents 41.5 per cent of the total.

Of the 47 municipalities having sewer systems in the Big Blue River Basin, 32 municipalities, with a sewered population equivalent of 74,000, have secondary treatment plants, and one town with a sewered population of 200 has a primary treatment plant. These 33 municipalities having sewage treatment plants represent 64 per cent of the sewered population, which compares favorably with the national average of roughly 60 per cent.

The sewered population equivalent of 74,200 that receives primary and secondary treatment is reduced to 21,665 sewered population equivalent, or a reduction of approximately 71 per cent. Generally this may be assumed to be an adequate degree of treatment, but local stream requirements, maintenance and operation of the treatment plants, and other factors, may alter this.

Laboratory Results

Average and median, summer-season, laboratory results together with data on sources of pollution and the location of existing and proposed dams are shown on Figures B-1 and B-2. Individual laboratory results are given in Appendix "H". The laboratory results confirm the conclusion that the pollution load in this basin is not great. In general, average B.O.D. values are less than 4 ppm and dissolved oxygen averages about 5 ppm or above. Exceptions are at Hastings, York, Seward, Fairbury, Osceola and Aurora, Nebraska, and Frankfort, Kansas where lower dissolved oxygen or higher B.O.D. values or both are indicated.

The median coliform index above the Marysville intake is approximately 10,000 per 100 ml. - a fairly high but not an excessive bacterial load for a properly operated rapid sand filter plant employing both pre-and post chlorination.

Excessive chloride concentrations are not a problem in this basin.

Low-Flow Frequencies

A brief study has been made of the frequency of low monthly flows, by months during the period of record. A summary of the results is shown in Tables B-7 and B-8. In computing the low mean monthly summer flow, the lowest monthly flow for the period June-September, inclusive, was used, while low mean monthly winter flows include December, and January and February of the following calendar year.

Low summer flows are of interest because of critical oxygen conditions which may occur during periods of high temperature. Low winter flows are of less importance normally because of the high oxygen capacity of streams at low temperatures and the naturally greater flows which occur during the winter. However, where ice formation may occur and where irrigation water is a principal consideration, winter flows may assume greater importance. Ice coverage of a stream forms a barrier to the absorption of oxygen and can reduce or even eliminate the reaeration capacity of a stream. Such conditions may require increased quantities of dilution water. Where conservation of winter flows for subsequent irrigation use is contemplated, it is desirable to have accurate determinations of winter requirements for sanitary purposes in order that maximum irrigation waters may be available.

U. S. Geological Survey Water Supply Paper 273 states that the Little Blue River, the principal tributary of the Big Blue, has a constant stream flow, even in periods of dry weather. This flow is derived from springs.

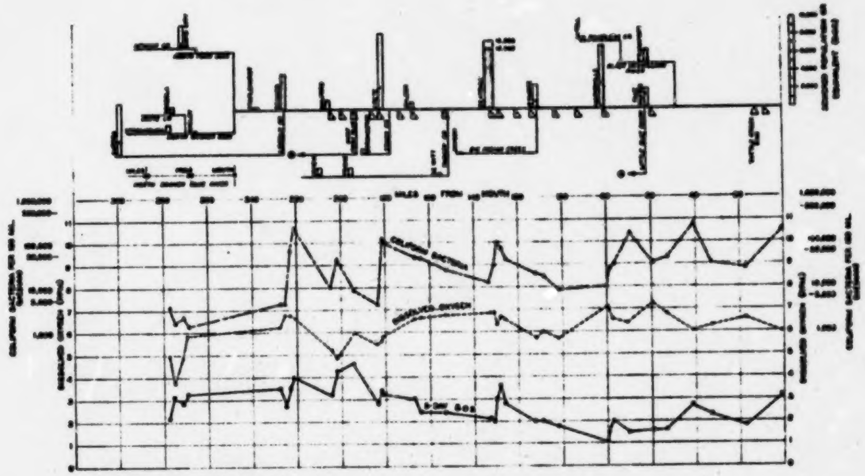
DISCUSSION

For the most part the sources of pollution are neither very great in quantity nor large in number when compared to other sections of the country. While at certain places along the main stem and its tributaries local nuisances and health hazards exist at times, the distance between sources of pollution is great enough to allow a marked degree of recovery between these points. Most of the critical conditions have developed where communities are situated on small streams and the discharged sewage forms all or a substantial portion of the flow during the warm dry season.

This is particularly true at Hastings, Nebraska (see Figure B-2). However, construction is underway to provide additional capacity to the sewage plant at this community which should assist considerably in relieving the situation.

Tests conducted on samples collected under ice during the

FIG. B-1



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE
[illegible]

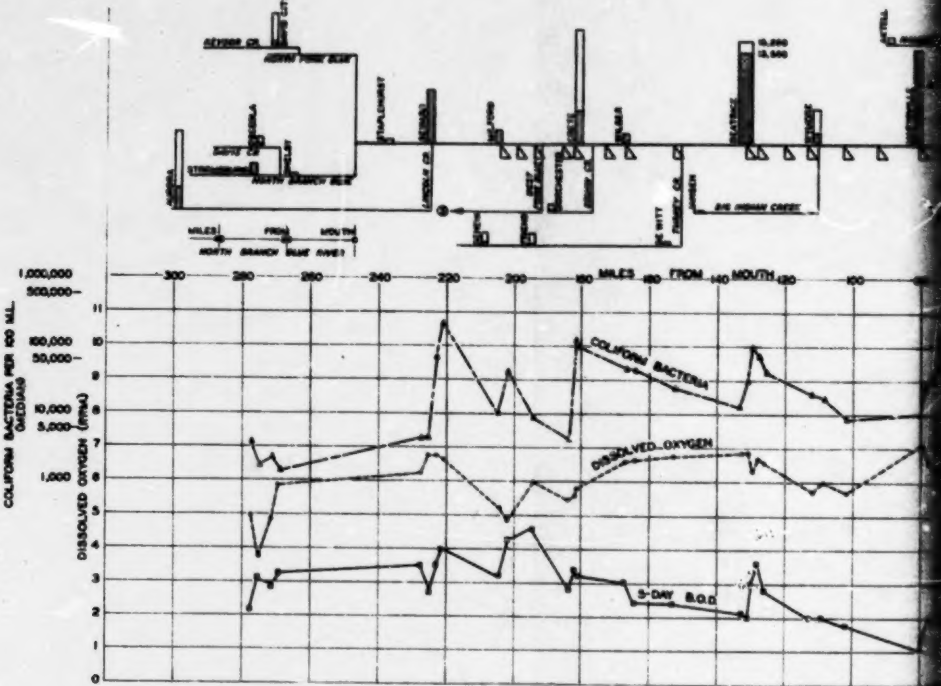
POLLUTION REMOVED BY TREATMENT
POLLUTION DISCHARGED

△ MAJOR DAMS (PROPOSED)
MINOR DAMS (MILL DAMS, ETC.)
● SEE SUPPLEMENTAL SHEETS

XXXXXXXXXXXXXXXXXXXXXXXXX
See the following pages
for greater detail.
XXXXXXXXXXXXXXXXXXXXXXXXX

BIG BLUE RIVER
SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS
SUMMER SEASON - 1948
(JUNE, JULY, AUG., SEPT.)

97-a



KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE
1949

▯ POLLUTION REMOVED BY TREATMENT
▮ POLLUTION DISCHARED

△ MAJOR DAMS (PROPOSED)
◺ MINOR DAMS (MILL DAMS, ETC.
③ SEE SUPPLEMENTAL SHEETS

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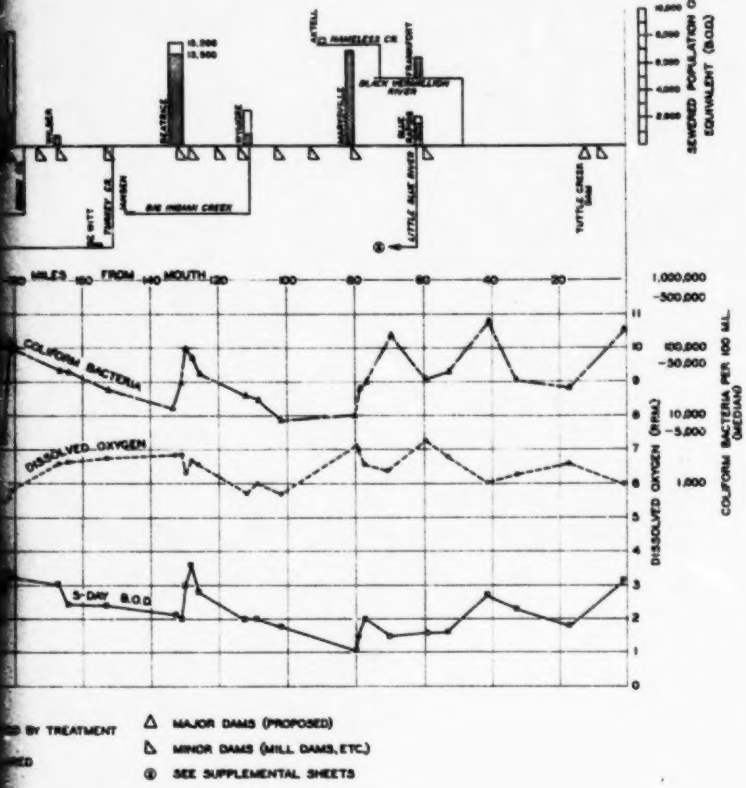
FIG. B-1



BIG BLUE RIVER

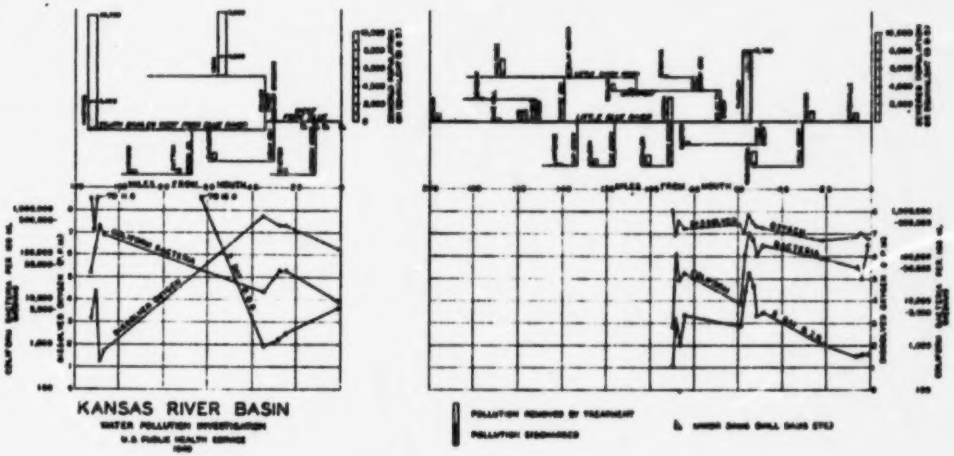
SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON - 1948
(JUNE, JULY, AUG, SEPT.)

B

97-a

FIG. B-2



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE
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See the following pages
for greater detail.
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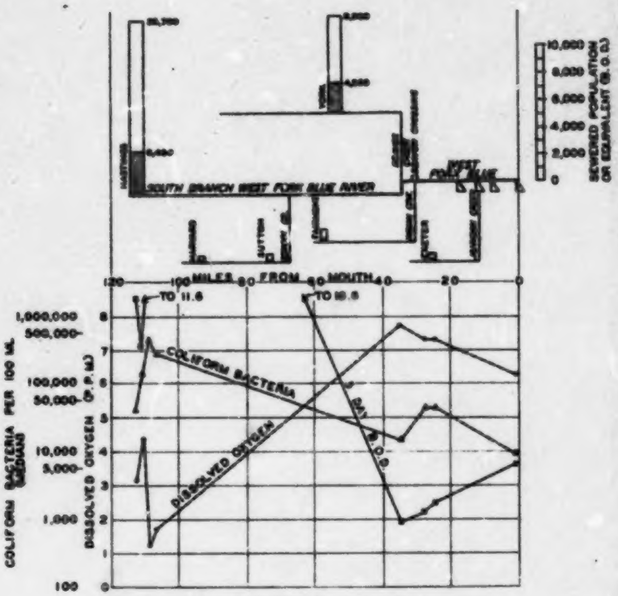
BIG BLUE RIVER TRIBUTARIES

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

[illegible]

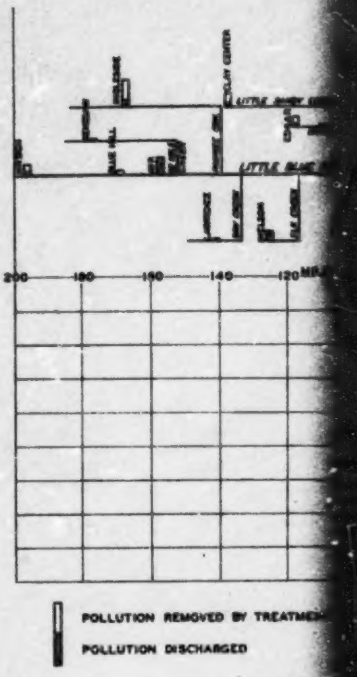
97-7



KANSAS RIVER BASIN

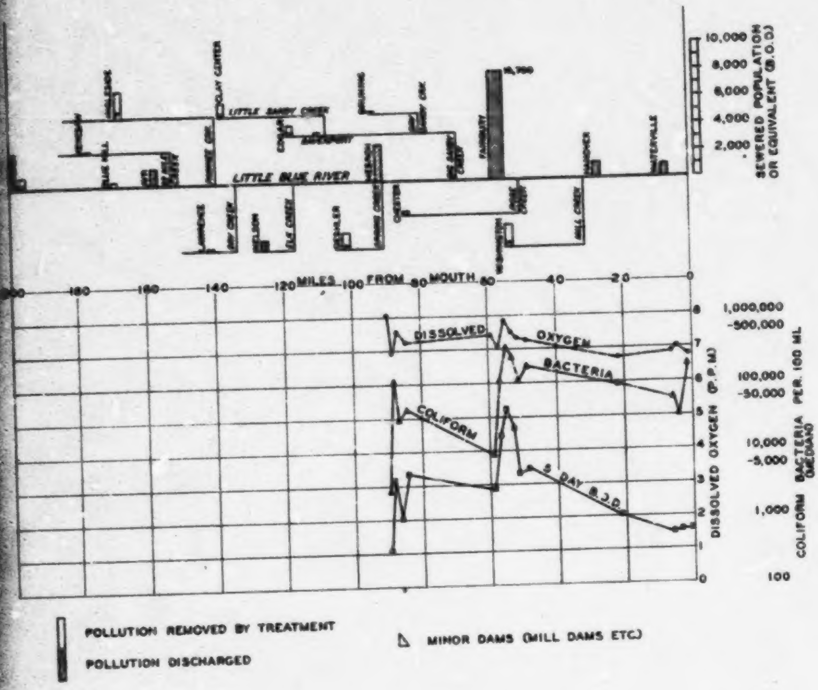
WATER POLLUTION INVESTIGATION

U.S. PUBLIC HEALTH SERVICE
1948



A

FIG. B-2



BIG BLUE RIVER TRIBUTARIES

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON - 1948
(JUNE, JULY, AUG., SEPT.)

B

97-7

Table B-7

Big Blue River Basin

Frequency of Low Mean Monthly Summer (June - Sept) Discharges

Years of Record	Stream and Location	Miles to Mouth		Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in:				
		Big Blue River	Tributary		2 years	3 years	5 years	10 years	Minimum*
	Big Blue River								
16	Randolph, Kans	32.3		9,099	480	270	140	100	78
13	Barnston, Nebr	103.0		4,360	130	92	54	28	21

Table B-8

Big Blue River Basin

Frequency of Low Mean Monthly Winter (Dec - Feb) Discharges

Years of Record	Stream and Location	Miles to Mouth		Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in:				
		Big Blue River	Tributary		2 years	3 years	5 years	10 years	Minimum*
	Big Blue River								
16	Randolph. Kans	32.3		9,099	270	250	220	185	179
13	Barnston, Nebr	103.0		4,360	130	125	110	90	68

* Low Mean Month

winter 1948 showed no excessive oxygen deficiency indicating that ice coverage was not complete enough to depress the dissolved oxygen concentrations.

The town of Marysville, Kansas, appears to present a special problem. The Kansas River Basin map showing major tributaries, issued by Corps of Engineers, Kansas City District, Kansas City, Missouri, March, 1947, indicates that the town of Marysville might be adversely affected at high pool stage. If the final design of the reservoir is such that the Big Blue River will be surcharged to Marysville, special provision will be necessary at both the water works intake and the sewer outlet, since the high water level would have the effect of combining the city's sewer discharge and raw water supply.

Usually the principal factor in a consideration of desirable stream flows is the use of the stream for public water supplies. The Big Blue River Basin, along the stream valleys, is underlain by an abundant ground water supply which might render the consideration of surface water supply of less importance. However, Water Supply Paper 273 calls attention to the report of salty water from wells in the Dakota sandstone along the Little Blue River Valley. It is also noted that at Gladstone in Jefferson County, and at a number of points between Powell and Steele, wells in the Dakota sandstone obtain saline water. In view of this it may be necessary in the future for additional municipalities to utilize surface water as sources of public water supplies.

Topeka and Lawrence, Kansas, along the main stem of the Kansas River, are the only communities below Tuttle Creek dam site that utilize river water as a source of municipal water supply. However, power plants located at Tecumseh near Topeka and at Lawrence use the Main Kansas River as a source of cooling water. Their combined use is approximately 180 million gallons daily. During periods of low flow, discharges from Tuttle Creek Reservoir would improve the raw water supplies and stream conditions at Topeka and Lawrence, and probably result in benefits to the power plants located at or near these cities. It will be noted in Table B-7 that the minimum flow to be expected once in ten years at Randolph, Kansas is 100 c.f.s.

REPUBLICAN RIVER BASIN

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REPUBLICAN RIVER BASIN

SYLLABUS

The Republican River rises in eastern Colorado and flows through portions of Nebraska and Kansas before joining the Smoky Hill River to form the Kansas River at Junction City, Kansas. Rainfall averages about 15 inches per year in the western portion of the basin and increases to as high as 30 inches per year in the lower portion. Farming and the processing of farm products are the dominating vocations. Irrigation, using both ground water and surface streams, is now practiced to a limited extent. A generally adequate supply of ground water serves all cities in the basin. Shortages in specific areas and future development may necessitate some use of surface supplies. Sources of pollution are relatively moderate but the discharge of raw sewage causes nuisances and public health hazards. In addition, the absence of flow during the summer season in many streams increases the pollution problem. All communities should provide a minimum of primary treatment, and secondary where local conditions indicate. McCook, Nebraska should provide secondary sewage treatment. About 30 dams and diversion structures for flood control, irrigation development and conservation are proposed for this basin and many are under construction. Stream flow regulation under planned reservoir operation will affect stream sanitation conditions particularly should discharges be less than the normal minimum mean flow of the unregulated streams. Any flow regulation program should consider the public health and stream sanitation aspects of such control. The use of sewage polluted waters for irrigation of low-growing fruits and vegetables consumed raw must be discouraged until additional studies develop satisfactory standards for the safe use of such waters.

CONCLUSIONS

(1) There are no municipal surface water supplies in the Republican River Basin; however, flow conditions will influence public water supplies at Topeka and Lawrence, Kansas, on the Kansas River, which two supplies furnish a population of 113,900 with 8.83 million gallons of water per day.

(2) There are 101 public water supplies in the basin obtained from ground water sources, furnishing a population of 110,843 with 14.95 million gallons of water per day.

(3) Sewage from a population of 79,250 and industrial wastes with a sewered population equivalent of 40,885 are produced in the Republican River Basin. Treatment in municipal treatment plants

reduces the pollution load of 120,135 to 90,420, a reduction of 25 per cent. Of the population connected to sewers, 60 per cent is tributary to sewage treatment facilities, although in certain cases treatment is not efficient.

(4) There are 22 reservoirs and 9 diversions contemplated for this Basin.

(5) New sewage treatment plants or plant improvements are needed at 13 of the 27 sewered cities discharging over 1,000 population equivalent in the Republican River Basin. Improved operation and maintenance are required in some cases.

(6) In general, unregulated minimum monthly average summer flows in the main stream are adequate if all cities provide primary sewage treatment. Exceptions are at Benkelman and McCook, Nebraska.

(7) Table R-10 indicates desirable flows at numerous locations on the main stem and its tributaries, based upon sanitation needs of the stream and primary sewage treatment at all cities. Also included are estimates of flows which are desirable if all cities provide secondary sewage treatment.

(8) Based upon preliminary estimates of minimum monthly mean flows resulting from a proposed flow regulation program, tangible annual monetary benefits and damages on the basis of sewage treatment needs to various cities are shown in Table R-10 and discussed in the text.

Table B-1 Republican River Basin - Reservoir Data

Reservoir	Tributary Stream	Miles to Mouth		Storage, Acre-Feet				Area Max. Pool Acres	Status
		Republican River	Tributary Stream	Silt and Conservation	Irrigation	Flood Control	Total		
Milford (c)	Republican River	19.4		40,000	0	700,000	740,000	25,000	Proposed
Lovewell (b)	White Rock Creek	136.5	12.0	2,000	20,000	8,000	30,000	2,280	Future Consid.
Thompson (b)	Thompson Creek	205.6	1.5	2,000	10,000	8,000	20,000	850	Future Consid.
Harlan County (c)	Republican River	236.2		200,000	150,000	500,000	850,000	23,300	Under Constr.
Woodruff	Prairie Dog Creek	239.8	21.7	-	-	-	-	-	Under Invest.
Norton (b)	Prairie Dog Creek	239.8	70.7	6,000	10,000	33,000	49,000	2,710	Authorized
Oberlin (b)	Sappa Creek	258.0	107.5	5,000	12,000	38,000	55,000	2,860	Future Consid.
Beaver Creek (b)	Beaver Creek	258.0	36.1	10,000	12,000	57,000	79,000	4,300	Future Consid.
Medicine Creek	Medicine Creek	309.6	9.5	15,000	25,000	53,000	93,000	3,420	Under Const.
Red Willow (b)	Red Willow Creek	329.6	14.5	5,000	10,000	22,000	37,000	1,480	Authorized
Blackwood	Blackwood Creek	350.2	9.8	-	-	-	-	-	Under Invest.
Culbertson	Frenchman River (Cr)	351.6	6.5	-	-	-	-	-	Under Invest.
Enders (b)	Frenchman River (Cr)	351.6	52.0	10,000	34,000	30,000	74,000	2,420	Under Constr.
Stinking Water	Stinking Water Creek	351.6	40.0	-	-	-	-	-	Under Invest.
Culbertson (b)	Republican River	354.2		32,000	45,000	18,000	95,000	6,150	Authorized
Benkelman (b)	So. Fk. Repub. R.	393.6	3.4	-	-	-	-	-	Under Invest.
St. Francis	So. Fk. Repub. R.	393.6	36.0	-	-	-	-	-	Under Invest.
Bonny (b)	So. Fk. Repub. R.	393.6	54.9	18,000	25,000	132,000	175,000	5,220	Under Const.
Stratton	So. Fk. Repub. R.	393.6	85.1	-	-	-	-	-	Under Invest.
Rock Creek (b)	Rock Creek	407.0	1.6	500	17,500	0	18,000	540	Recommended
Wray (b)	No. Fk. Repub. R.	421.7	24.2	500	5,500	1,000	7,000	520	Authorized
Pioneer (c)	Arikaree R.	421.7	7.5	26,000	10,000	73,000	109,000	3,380	Authorized

(b) - Data from Bureau of Reclamation (c) - Data from Corps of Engineers

RESERVOIR PROJECTS

Table R-1 presents summarized information on reservoir projects in various stages of consideration or construction, in accordance with information furnished by the Bureau of Reclamation and Corps of Engineers. The 22 reservoirs listed are those remaining from the consideration of a somewhat greater number of possibilities. It is to be noted that of this number, 11 reservoirs are either under construction, authorized, or recommended. Additional reservoirs eventually may be added from those listed as under investigation or for future consideration. Four reservoirs are now under construction; namely, Harlan County, Medicine Creek, Enders and Bonny. These four reservoirs are among the larger ones proposed for the basin and represent 49 per cent of the total capacity to be provided by the 15 reservoirs now being considered, not including those under investigation and for which capacities are not now available. A summary of Table R-1 in which reservoirs are classified in accordance with their status is shown in Table R-2.

Table R-2 - Republican River Basin - Summary of Reservoir Data

		Storage - 1000 Acre-Feet			
Status	No.	Silt	Irrigation	Flood Control	Total
Under construction	4	243	234	715	1,192
Authorized	5	69.5	80.5	147	297
Recommended (or proposed)	2	40.5	17.5	700	758
Future consideration	4	19	54	111	184
Under investigation	7	-	-	-	-
Total	22	372*	386*	1,673*	2,431*

* Excludes reservoirs under investigation.

DESCRIPTION

The Republican River is about 422 miles long from its headwaters at the junction of North Fork and Arikaree Rivers in the southwest corner of the State of Nebraska to its mouth in eastern Kansas where it joins with the Smoky Hill River to form the Kansas River. The principal tributaries of interest in connection with the present survey are shown in Table R-3.

Table R-3 - Republican River Basin - Principal Tributaries

Tributary	Miles Above Republican River Mouth	Drainage Area Square Miles
Prairie Dog Creek	239.8	1,007
Sappa Creek	258.0	3,789
Beaver Creek	270.3	2,107
Medicine Creek	309.6	874
Frenchman River (Creek)	351.6	3,765
South Fork Republican River	393.6	2,726
North Fork Republican River	421.7	1,998
Arikaree River	421.7	1,918

The lower 140 miles of the Republican River are in Kansas, and the balance of the river, about 280 miles, is in Nebraska. Of the 24,955 square miles of drainage area in the Republican River Basin, the distribution among the three States is approximately as follows: Kansas, 7,245 square miles; Nebraska, 10,060 square miles; and Colorado, 7,650 square miles.

Table R-4 lists 103 municipalities in the Republican River Basin.Of these, 74 had populations in 1940 of less than 1,000. There are no dominating large cities in the basin, the only three cities with 1940 populations in excess of 5,000 being as follows: Junction City, Kansas, 8,507; Concordia, Kansas, 6,255; and McCook, Nebraska 6,212.

Activities in the basin are almost entirely confined to agriculture, the western part of the Republican River Basin being devoted to cattle raising and the eastern section being devoted quite largely to grain.

An important characteristic of the Republican River Basin is the variation in rainfall which averages little more than 15 inches per year in the extreme western area and increases rather uniformly to as high as 30 inches per year in the lower few miles of the basin. Large portions of the western area are classed as noncontributing to stream flow as a consequence of the very low rainfall.

PRESENTATION OF DATA

Public Water Supplies

There are no municipalities in the Republican River Basin obtaining public water supplies from surface sources. Flow conditions

Table B-4

Republican River Basin

Population of Cities

City	Population - U. S. Census			
	1920	1930	1940	1948*
Almena, Kansas	674	703	543	579
Atwood, Kansas	919	1,166	1,408	1,416
Aurora, Kansas	275	256	274	232
Belleville, Kansas	2,254	2,383	2,560	2,729
Bird City, Kansas	489	740	694	687
Brewster, Kansas	-	487	408	438
Burr Oak, Kansas	638	595	530	524
Clay Center, Kansas	3,715	4,386	4,518	4,196
Clayton, Kansas	258	226	153	123
Clifton, Kansas	631	713	670	652
Clyde, Kansas	1,063	1,174	1,060	1,100
Colby, Kansas	1,114	2,153	2,458	3,476
Concordia, Kansas	4,705	5,792	6,255	6,775
Courtland, Kansas	413	430	383	379
Cuba, Kansas	482	403	363	346
Formoso, Kansas	374	381	293	260
Goodland, Kansas	2,664	3,626	3,306	4,087
Green, Kansas	297	293	248	204
Herndon, Kansas	411	430	448	331
Jamestown, Kansas	495	507	490	485
Jennings, Kansas	253	344	311	306
Jewell, Kansas	805	707	669	674
Junction City, Kansas	7,533	7,407	8,507	10,890
Kanorado, Kansas	-	359	322	312
Linn, Kansas	282	340	395	392
Long Island, Kansas	286	242	257	296
McDonald, Kansas	341	442	425	411
Mankato, Kansas	1,326	1,404	1,426	1,452
Milford, Kansas	--	300	271	239
Morganville, Kansas	262	281	264	246
Norcatur, Kansas	476	524	440	374
Norton, Kansas	2,186	2,767	2,762	3,014
Oberlin, Kansas	1,247	1,629	1,678	2,000
Palmer, Kansas	179	187	182	150
Randall, Kansas	304	262	281	280
Republic, Kansas	442	396	376	344
Rexford, Kansas	237	375	244	301
St. Francis, Kansas	733	944	1,041	1,597
Scandia, Kansas	547	608	614	589
Selden, Kansas	280	399	401	470
Wakefield, Kansas	531	528	513	518
Alma, Nebraska	1,058	1,235	1,272	2,000
Arapahoe, Nebraska	894	1,017	1,002	1,250
Bartley, Nebraska	381	435	380	400
Beaver City, Nebraska	1,103	11,024	1,015	1,200
Benkelman, Nebraska	1,009	1,154	1,448	1,900
Bloomington, Nebraska	503	431	361	-
Cambridge, Nebraska	1,042	1,203	1,084	-
Cowles, Nebraska	220	224	158	-
Culbertson, Nebraska	686	820	815	-
Curtis, Nebraska	1,017	960	952	1,000
Danbury, Nebraska	293	321	236	-

Table B-4

Republican River Basin

Population of Cities (continued)

City	Population - U. S. Census			
	1920	1930	1940	1948*
Elsie, Nebraska	201	262	223	-
Elwood, Nebraska	473	509	633	-
Franklin, Nebraska	1,055	1,103	1,272	1,725
Grant, Nebraska	585	798	897	-
Guide Rock, Nebraska	611	690	596	-
Haigler, Nebraska	460	535	507	-
Hayes Center, Nebraska	-	229	314	-
Hamlet, Nebraska	-	199	220	-
Hardy, Nebraska	446	399	341	-
Hildreth, Nebraska	353	400	361	-
Holbrook, Nebraska	455	488	441	-
Holdrege, Nebraska	3,108	3,263	3,360	5,158
Huntley, Nebraska	170	179	148	-
Imperial, Nebraska	723	946	1,195	1,550
Indianola, Nebraska	742	815	800	-
Lebanon, Nebraska	245	262	238	-
Loomis, Nebraska	238	213	249	-
McCook, Nebraska	4,303	6,688	6,212	8,500
Madrid, Nebraska	218	449	410	475
Maywood, Nebraska	533	525	426	-
Naponee, Nebraska	263	252	272	-
Orleans, Nebraska	954	985	818	-
Oxford, Nebraska	739	1,156	1,141	1,350
Palisade, Nebraska	627	731	799	835
Red Cloud, Nebraska	1,856	1,519	1,610	1,610
Republican City, Nebraska	424	417	331	650
Riverton, Nebraska	399	328	390	-
Stamford, Nebraska	302	297	260	-
Stockville, Nebraska	196	186	238	-
Stratton, Nebraska	509	663	630	645
Superior, Nebraska	2,719	3,044	2,650	3,162
Trenton, Nebraska	592	865	920	-
Upland, Nebraska	433	367	317	-
Venango, Nebraska	265	286	214	-
Wallace, Nebraska	327	406	335	-
Wauneta, Nebraska	572	793	770	-
Wilcox, Nebraska	368	343	310	-
Wilsonville, Nebraska	470	469	362	-
Akron, Colorado	1,401	1,135	1,417	2,000
Arriba, Colorado	334	337	286	-
Burlington, Colorado	991	1,260	1,280	2,500
Eckley, Colorado	332	359	358	-
Flagler, Colorado	544	540	506	-
Haxtun, Colorado	1,118	1,027	985	1,200
Holyoke, Colorado	1,205	1,226	1,150	1,400
Otis, Colorado	467	529	498	-
Seibert, Colorado	311	273	249	-
Stratton, Colorado	421	507	623	-
Vona, Colorado	268	183	226	-
Wray, Colorado	1,[illegible]	1,785	2,061	3,000
Yuma, Colorado	1,177	1,360	1,606	-

* Estimated
Kansas populations from Kansas State Board of Agriculture Bulletin "Population of Kansas" August 24, 1948.

on the Republican River, however, will have some influence on the public water supplies of Topeka and Lawrence. The public water supply of Topeka supplies a population of 87,000 with 7.13 million gallons per day, and the public water supply at Lawrence supplies a population of 26,900 with 1.70 million gallons per day.

While there are no surface supplies in the Republican River Basin, there are 101 public water supplies obtained from ground sources, as shown on Table R-5, which serve a population of 110,843 with a total of 14.95 million gallons per day. Consideration of ground water supplies is of interest in cases where such supplies are limited, giving rise to possible future necessities of using surface supplies.

Sources of Pollution

Table R-6 summarizes the location and magnitude of significant sources of organic pollution, including industrial wastes discharged to streams in the Republican River Basin. This table indicates that the population connected to sewers in the basin totals about 79,250. To this must be added organic pollution from industrial wastes with a sewered population equivalent of about 40,885, making a total population load prior to treatment of 120,135.

The total pollution load is reduced from 120,135 to 90,420 sewered population equivalent by treatment in municipal sewage treatment plants, or a reduction of 25 per cent. Of perhaps more significance is the proportion of sewage receiving treatment, as in many cases the residual pollution in the treated effluent is sufficiently low to be absorbed by the natural flow of the outlet stream without objection and the pollution situation is, for practical purposes, corrected. Of the 46 municipalities having sewer systems in the Republican River Basin, 26 municipalities, with a population of 32,340 have either primary or secondary sewage treatment plants. Seven cities having a total sewered population of 14,870 provide septic tank treatment which is less efficient than standard primary treatment. This means that 60 per cent of the sewered population is supplied with sewage treatment facilities ranging from septic tank to secondary treatment systems. This average record coincides with the 60 per cent of sewage treatment for sewered populations in the United States. In this Basin 22 of the 60 per cent receive primary or septic tank treatment and the remaining 38 per cent receive secondary treatment.

Table R-5 shows that a population of approximately 110,843 in the Republican River Basin is served by municipal water supplies while the population connected to sewers (Table R-6) is about 79,250. Consequently, as this area is developed and the proportion of sewered population in relation to those served by municipal water

Table B-5

Republican River Basin

Municipal Water Supplies From Ground Sources

Municipality	State	Source (1)	Treatment (2)	Population Served	Average Consumption M. G. D.
Almena	Kans	SW	N	576	0.15
Atwood	Kans	SW	D	1,400	0.15
Aurora	Kans	DW	N	160	0.01
Belleville	Kans	DW	D	2,700	0.20
Bird City	Kans	DW	N	630	0.08
Brewster	Kans	DW	N	438	0.02
Burr Oak	Kans	SW	D	480	0.02
Clay Center	Kans	SW	Dp	4,000	0.60
Clayton	Kans	SW	N	110	0.02
Clifton	Kans	SW	DH	520	0.125
Clyde	Kans	DW	HFD	1,046	0.18
Colby	Kans	DW	N	3,560	0.35
Concordia	Kans	DW,SW	D	6,775	0.92
Courtland	Kans	SW	D	260	0.02
Cuba	Kans	DW	N	330	0.01
Formoso	Kans	SW	N	200	0.01
Goodland	Kans	DW	D	5,000	0.75
Green	Kans	DW	Dp	170	0.01
Herndon	Kans	SW	D	320	0.08
Jamestown	Kans	DW	N	460	0.06
Jennings	Kans	SW	N	260	0.03
Jewell	Kans	SW	FD	610	0.04
Junction City	Kans	SW	DH	10,900	1.64
Kanorado	Kans	DW	N	260	0.04
Linn	Kans	SW	I	330	0.02
Long Island	Kans	SW	N	220	0.01
McDonald	Kans	DW	N	400	0.03
Mankato	Kans	SW	D	1,460	0.10
Milford	Kans	SW	N	160	0.01
Morganville	Kans	SW	N	160	0.03
Norcatur	Kans	DW	N	320	0.05
Norton	Kans	SW	D	3,400	0.35
Oberlin	Kans	SW	N	2,000	0.30
Palmer	Kans	SW	N	120	0.01
Randall	Kans	SW	N	220	0.01
Republic	Kans	SW	N	320	0.01
Rexford	Kans	DW	N	250	0.02
St. Francis	Kans	SW	Dp	1,500	0.32
Scandia	Kans	SW	N	550	0.04
Selden	Kans	DW	N	380	0.02
Wakefield	Kans	SW	N	500	0.08
Alma	Nebr	DW	N	1,800	0.30
Arapahoe	Nebr	W	N	1,050	0.20
Atlanta	Nebr	DW	N	100	0.01
Bartley	Nebr	W	N	200	0.02
Beaver City	Nebr	W	N	1,090	0.40
Benkelman	Nebr	W	N	1,600	0.20
Bertrand	Nebr	DW	N	500	0.20
Bloomington	Nebr	W	N	250	0.10
Cambridge	Nebr	W	N	950	0.30
Culbertson	Nebr	W	N	700	0.06
Curtis	Nebr	W	N	900	0.05
Danbury	Nebr	W	N	235	0.04
Edison	Nebr	W	N	280	0.01
Elsie	Nebr	DW	N	190	0.02
Elwood	Nebr	DW	N	510	0.03

Table B-5 **Republican River Basin**

Municipal Water Supplies From Ground Sources (continued)

Municipality	State	Source (1)	Treatment (2)	Population Served	Average Consumption M. G. D.
Bustis	Nebr	DW	N	400	0.15
Franklin	Nebr	W	N	1,800	0.30
Grant	Nebr	DW	N	800	0.20
Haigler	Nebr	W	N	480	0.03
Hardy	Nebr	W	N	200	0.03
Hayes Center	Nebr	DW	N	200	0.05
Hildreth	Nebr	DW	N	290	0.02
Holbrook	Nebr	W	N	440	0.02
Holdrege	Nebr	DW	N	4,800	0.80
Imperial	Nebr	DW	N	1,390	0.10
Indianola	Nebr	W	N	800	0.05
Loomis	Nebr	DW	N	200	0.02
McCook	Nebr	W	D	8,500	1.00
Madrid	Nebr	DW	N	350	0.008
Maywood	Nebr	W	N	250	0.03
Naponee	Nebr	W	N	200	0.02
Orleans	Nebr	W	N	900	0.05
Oxford	Nebr	W	N	1,000	0.10
Palisade	Nebr	W	N	700	0.05
Red Cloud	Nebr	W	N	1,500	0.20
Republican City	Nebr	DW	N	250	0.01
Riverton	Nebr	W	N	250	0.01
Ruskin	Nebr	W	N	170	0.02
Stamford	Nebr	W	N	230	0.02
Stockville	Nebr	W	N	200	0.015
Stratton	Nebr	W	N	600	0.18
Superior	Nebr	W	HFD	3,000	0.40
Trenton	Nebr	W	N	850	0.05
Upland	Nebr	DW	N	300	0.01
Venango	Nebr	DW	N	214	0.02
Wauneta	Nebr	W	N	800	0.07
Wilcox	Nebr	DW	N	290	0.03
Wilsonville	Nebr	W	N	350	0.035
Akron	Colo	W	N	2,000	0.35
Burlington	Colo	DW	N	2,500	0.30
Eckley	Colo	DW	N	300	0.03
Flagler	Colo	W	N	570	0.06
Haxtun	Colo	DW	N	1,200	0.25
Holyoke	Colo	DW	N	1,340	0.35
Otis	Colo	W	N	500	0.06
Seibert	Colo	W	N	250	0.01
Stratton	Colo	W	N	720	0.06
Vona	Colo	W	N	200	0.02
Wray	Colo	DW	N	3,000	0.30
Yuma	Colo	W	N	2,000	0.20
Total				110,843	14.953

(1) Source -
W - Wells
SP - Springs
SW - Shallow Wells
DW - Deep Wells

(2) Treatment -
N - None
F - Coagulated, Settled, Filtered
D - Chlorinated
Dp - Partially Chlorinated
H - Softened
I - Iron Removal

Table 2-6

Republican River Basin

Sources of Pollution Including Industrial Wastes Expressed as Sewered Population Equivalent (B.O.D.)

Municipality	State	Miles Above Mouth Repub. River	Miles Above Mouth Tributary	Population Connected to Sewers	Treatment (1)	Sewered Population Equivalent (B.O.D.) Untreated	Sewered Population Equivalent (B.O.D.) Discharged
Republican River							
Junction City	Kans	4.2		10,700	N	11,865	11,865 (2)
Wakefield	Kans	26.7		500	N	500	500
Clay Center	Kans	42.1		4,000	N	6,195	6,195
Clifton	Kans	69.5		820	P	830	540
Clyde	Kans	81.8		770	ST	770	615
Salt Creek		90.7					
Belleville	Kans		20.4	2,000	S	4,690	1,115
Concordia	Kans	102.4		5,750	N	10,410	10,410
Buffalo Creek		105.8					
Mankato	Kans		55.0	1,130	S	1,130	270
Scandia	Kans	125.2		475	N	475	475
Superior	Nebr	154.4		2,800	N	11,200	11,200
Red Cloud	Nebr	186.7		1,500	N	4,650	4,650
Franklin	Nebr	218.4		1,600	N	1,600	1,600
Turkey Creek		232.3					
Holdrege	Nebr		40.0	4,600	S	7,560	1,870
Prairie Dog Creek		239.8					
Almena	Kans		49.6	400	S	400	100
State Sanatorium at Norton			60.7	500	S	500	125
Norton	Kans		66.0	2,640	S	2,890	660
Colby	Kans		157.0	3,190	S	3,190	1,440
Alma	Nebr	247.4		1,700	N	4,370	4,370
Orleans	Nebr	255.0		815	N	3,500	3,500
Sappa Creek		258.0					
Beaver Creek			12.3				
Beaver City	Nebr		16.8	1,000	ST	1,000	500
Herndon	Kans		116.5	260	S	260	65
Atwood	Kans		135.7	1,400	S	1,400	350
Burlington	Colo		236.2	1,900	P	1,900	1,200 (6)
Oberlin	Kans		100.8	1,450	S	1,780	445
South Fork Sappa Creek			107.8				
Brewster	Kans		78.0	420	S	420	105
North Fork Sappa Creek			107.8				
Goodland	Kans		99.0	2,800	S	2,800	700
Spring Creek		267.6					
Bertrand	Nebr		23.0	300	S	300	75
Oxford	Nebr	279.8		1,000	S	2,520	760
Arapahoe	Nebr	292.6		1,000	N	1,000	1,000
Holbrook	Nebr	300.5		400	S	400	120
Medicine Creek		309.6					
Cambridge	Nebr		0.8	750	S	750	225
Curtis	Nebr		35.0	900	S	900	250
Indianola	Nebr	325.8		800	S	800	400
McCook	Nebr	339.3		7,500	ST	14,300	14,300 (4)
Frenchman River (Creek)		351.6					
Culbertson	Nebr		1.2	600	N	600	600
Stinking Water Creek			28.5				
Spring Creek			20.1				
Grant	Nebr		32.0	600	S	600	120
Palisade	Nebr		23.6	450	S	450	160
Wauneta	Nebr		42.3	600	N	600	600
Imperial	Nebr		66.0	1,250	S	1,250	625 (3)
Holyoke	Colo		102.0	900	ST	900	720 (5)
Haxtun	Colo		124.0	700	ST	700	560 (3)
Trenton	Nebr	362.4		850	S	850	300
Stratton	Nebr	374.9		610	S	610	240
Benkelman	Nebr	393.5		1,600	ST	1,600	1,600 (4)
S. Fork Republican River		393.6					
St. Francis	Kans		28.0	1,220	S	1,220	300
N. Fork Republican River		421.7					
Wray	Colo		19.5	2,400	ST	3,500	2,600
Total				79,280		120,135	90,420

(1) Treatment -
N - None
P - Primary
S - Secondary
ST- Septic Tank

(2) Unknown percentage to Smoky Hill River

(3) Land Application

(4) No effective removal

(5) Lagoon in dry creek bed

(6) No discharge to streams - effluent used for irrigation

supplies increases, a greater pollutional load on the streams may be anticipated.

Low-Flow Frequencies

A brief study has been made of the frequency of low monthly flows, by months, during the period of record. A summary of the results of the study is shown on Tables R-7 and R-8. Consideration of the frequency of minimum flows is of interest in connection with pollution studies as an indication of the frequency which objectionable conditions of various magnitudes have occurred in the past. In computing the low monthly flow frequency, the lowest monthly flow only for each year of record is used. Low summer flows have included the months from June to September, inclusive, and low winter flows have included December, and January and February, of the following calendar year.

Low summer flows are of interest because of critical oxygen conditions which may occur during periods of high temperature. Winter flows are of less importance, normally, because of the lesser need for dilution water at low temperatures and the naturally higher flows which occur, in the eastern portion of the United States, during the winter. However, where ice conditions are important, and where irrigation water is a principal consideration, winter flows may also assume great importance. Ice conditions create a need for dilution water, as the reaeration capacity of a stream may be entirely eliminated. At places where irrigation is a principal consideration, it may be desired to store winter flows in order to secure maximum irrigation benefits. An accurate determination of winter requirements for sanitary purposes, is therefore, extremely important in order that maximum use may be made of available winter flows without creating great damages to other water uses.

Low-Flow Variations

The use of water for stream sanitation purposes requires the presence of specific amounts at locations that may be at various distances below impoundments. It is, therefore, necessary to ascertain what will happen to the water in the interval between its discharge from a dam to its use at a definite location. Losses occurring in this stretch of the stream must be added to the required amounts of water to arrive at the discharge from the impoundment.

A review of Table R-7, "Frequency of Low Mean Monthly Summer (June to September) Discharges in the Republican River Basin" shows that the flow in the stream may decrease when comparing downstream locations against those upstream. For instance, the minimum monthly flow at Max, Nebraska, is 1 c.f.s., while 35 miles downstream at Culbertson, Nebraska, the minimum flow is zero. Likewise, it will

Table B-7

Republican River Basin

Frequency of Low Mean Monthly Summer (June - Sept) Discharges

Years of Record	Stream and Location	Miles to Mouth		Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in:				
		Repub. River	Tributary		2 years	3 years	5 years	10 years	Minimum*
	Republican River								
16	Clay Center, Kans	42.1		24,870	400	300	205	60	2
15	Hardy, Nebr	145.1		22,410	350	202	52	30	18
13	Harlan County Reservoir, Nebr	236.2		20,755	340	100	30	10	0
16	Culbertson, Nebr	351.9		7,897	19	3	1	0	0
15	Max, Nebr	385.6		7,188	23	9	2	1	1
	Prairie Dog Creek	239.8							
12	Norton, Kans		66.0	731	10	4	2	2	2
	Sappa Creek	256.0							
10	Oberlin, Kans		100.7	1,073	5	3	2	1	0
	Beaver Creek		12.3						
9	Beaver City, Nebr		24.7	1,964	13	4	2	1	0
	Medicine Creek	309.6							
8	Cambridge, Nebr		3.0	884	46	44	42	32	20
	Red Willow Creek	329.6							
6	Red Willow, Nebr		3.7	760	18	16	13	9	9
	Frenchman River (Creek)	361.6							
16	Hamlet, Nebr		32.1	2,386	74	72	71	69	68
	S. Fork Republican River	393.6							
8	Benkelman, Nebr		3.6	2,721	1	0	0	0	0
10	Bonny Dam Site, Nebr		54.9	1,875	10	6	6	3	0
	N. Fork Republican River	421.7							
7	Wray, Colo		23.0	169	17	16	15	14	14
	Arikaree River	421.7							
14	Haigler, Nebr		0.6	1,914	3	2	2	2	2

Table B-8

Republican River Basin

Frequency of Low Mean Monthly Winter (Dec - Feb) Discharges

Years of Record	Stream and Location	Miles to Mouth		Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in:				
		Repub. River	Tributary		2 years	3 years	5 years	10 years	Minimum*
	Republican River								
16	Clay Center, Kan.	42.1		24,870	285	240	220	200	91
14	Hardy, Nebr	145.1		22,410	260	223	200	160	102
12	Harlan County Reservoir, Nebr	236.2		20,755	238	220	175	125	116
14	Culbertson, Nebr	351.9		7,897	155	120	71	60	56
15	Max, Nebr	385.6		7,188	130	106	82	64	60
	Prairie Dog Creek	239.8							
12	Norton, Kans		66.0	731	0	0	0	0	0
	Sappa Creek	256.0							
10	Oberlin, Kans		100.7	1,073	11	8	5	2	2
	Beaver Creek		12.3						
8	Beaver City, Nebr		24.7	1,964	1	0	0	0	0
	Medicine Creek	309.6							
8	Cambridge, Nebr		3.0	884	49	44	41	38	36
	Red Willow Creek	329.6							
6	Red Willow, Nebr		3.7	740	26	21	16	13	12
	Frenchman River (Creek)	361.6							
16	Hamlet, Nebr		32.1	2,386	98	90	82	76	70
	S. Fork Republican River	393.6							
8	Benkelman, Nebr		3.6	2,721	41	28	18	12	10
10	Bonny Dam Site, Nebr		54.9	1,875	36	33	30	26	23
	N. Fork Republican River	421.7							
7	Wray, Colo		23.0	169	22	22	22	21	21
	Arikaree River	421.7							
15	Haigler, Nebr		0.6	1,914	11	6	4	3	1

* Low Mean Month

be noted that the minimum monthly mean flow in the North Fork Republican River is 14 c.f.s.; Frenchman Creek, 63 c.f.s.; and Medicine Creek, 20 c.f.s.; although the minimum monthly mean flow in the main stem below these tributaries may be zero. A similar condition exists when we consider the minimum monthly mean flows that may be expected once in 10 years. This condition has been previously observed and reported in Water Supply Paper 273 (1) which contains the following pertinent observations: "Throughout its course in Nebraska the stream flows in cretaceous deposits and is supplied by spring-fed tributaries. In the western counties, where the rainfall is small and direct runoff rapid, the river bed is often dry, as for example, in midsummer, immediately above mouths of Buffalo, Rock, and Frenchman Creeks, but these streams revive the flow of the river below their mouths. Such alternating dryness and flow extend as far east as Superior, Nebraska, during droughts, but only once in 12 years has the river ceased to flow at Red Cloud and Superior."

The source of flows in the tributaries to the north of the Republican River is evidently from springs fed, at least partially, by an underflow from the Platte River to the Republican River Basin. This is definitely a possibility because the Platte River Valley has a considerably greater altitude than the Republican River Valley and between the valleys a pervious strata lies between the loess and top of the impervious Pierre shale (1). Likewise, A. L. Lugn, Professor of Geology, University of Nebraska, states (2) that water migrates underground from the Platte to the Republican and Blue River Basins and that the Republican River intercepts all underflow from the north and northwest while everywhere south of the Republican River impervious shale bedrock rises high above the water table and prevents the escape of any water to the south. Discussions with State geologists and others who are acquainted with conditions in this area confirm in general the concepts propounded by Mr. Parker (1) and Professor Lugn (2).

Therefore, with reasonable assurance, it may be stated that: (a) the flows of tributaries originating north of the Republican River are fed, at least somewhat, by underground water originating from the Platte River Basin; (b) the Republican River probably intercepts some underground flows originating in the Platte River

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1. Parker, H. N., "Quality of the Water Supplies of Kansas," Water-Supply Paper 273 - U.S.G.S. (1911)

2. Lugn, A. L., "Ground Water in Nebraska," Unpublished Report. Similar article "Ground Water Worth Millions" published in Nebraska Farmer (Feb. 22, Mar. 8, Mar. 22, 1941)

Basin; (c) underground water flow is southward to the Republican River; and, (d) there is no underground flow southward from the Republican River Valley except in the eastern portion where there may be percolation to the Blue River Valley. These factors indicate that ground water flow is to the river bed.

Other factors associated with the alternating dryness and flow in the Republican River should be considered. Evaporation undoubtedly plays a considerable role as indicated in Table R-9, showing evaporation rates at various locations in the basin. In the vicinity of Culbertson and Harlan County Dam, the expected evaporation rates will be at least 9.5 inches per month during July. It is possible that in the Republican River, which for the most part is shallow and has a relatively wide sandy bed, evaporation rates may exceed those given in the table. Another factor to be considered is the loss of water due to transpiration. The banks of the Republican River are lined with a considerable growth of trees and underbrush and there is little doubt that considerable quantities of water are removed from the river in this fashion. Irrigation is practiced to a limited extent and utilizes river water in many instances. Water Supply Paper 273 (1911) (1), notes "At some points in the western part of the area the entire flow of the stream is diverted for irrigation." Another possibility may be that during extreme low flows the water percolates downstream through the sands of the wide river bed without giving any indication of actual flow. Therefore, it appears that the factors affecting the variation or disappearance of flow in the Republican River during summer low flow periods are evaporation, transpiration, possibly irrigation, and dispersion of low flow in the sands of the river bed.

Future considerations, however, must allow for changes inherent to irrigation developments. Waste water and return flows undoubtedly will alter existing conditions with the possibility that there will be an influx rather than a decrease of water in the river channel below impoundments and diversions.

Laboratory Results

Main Stem Republican River - Average summer season dissolved oxygen, B.O.D., and median coliform results are shown on Figures 6, 7 and 8 and on Figure R-1. Average and maximum chloride results are shown on Figures 9 and 10. A summary of all individual results is presented in Appendix "H".

Average dissolved oxygen levels are satisfactory and except below McCook and Superior, Nebraska, and Concordia, Kansas, are substantially in excess of the B.O.D. The average summer season

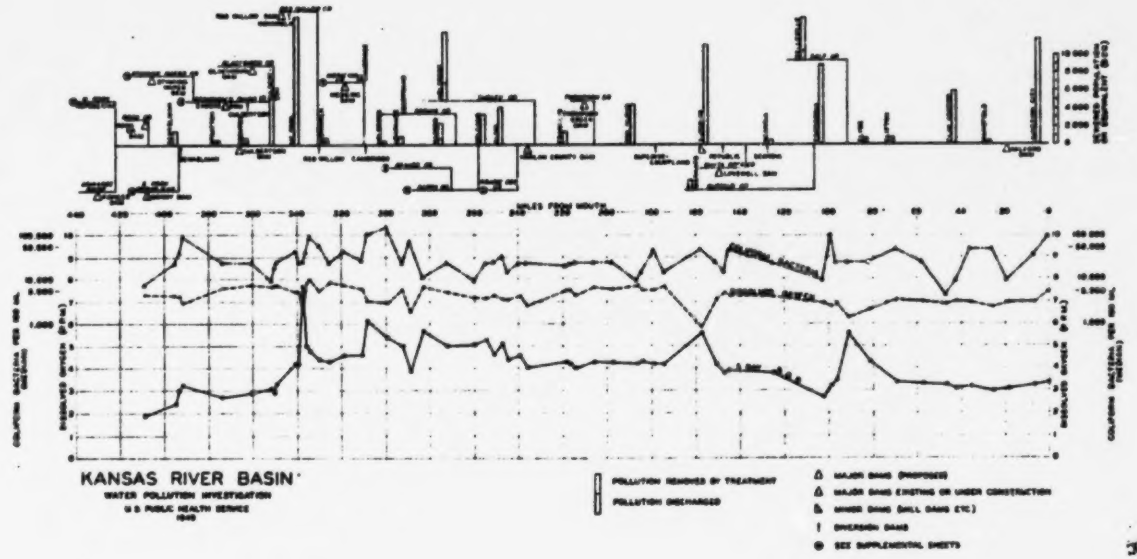
Table R-9 Republican River Basin

Mean Evaporation in Inches from Shallow Lakes and Reservoirs at Various Locations in the Republican River Basin

Month	Location			
	Harlan Co.	Culbertson	Beaver City	Colby
January	1.00	1.25	1.00	1.35
February	1.25	1.40	1.25	1.60
March	2.25	2.40	2.28	2.60
April	3.75	3.90	3.80	4.20
May	5.00	5.40	5.20	5.55
June	6.90	7.00	6.95	7.40
July	9.50	9.50	9.60	10.10
August	8.60	8.75	8.70	9.10
September	7.25	7.25	7.30	7.70
October	4.70	4.90	4.80	5.10
November	2.67	2.85	2.70	2.97
December	1.20	1.45	1.25	1.65

* Prepared from data submitted by Bureau of Reclamation

FIG. R-1



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See the following pages
for greater detail.
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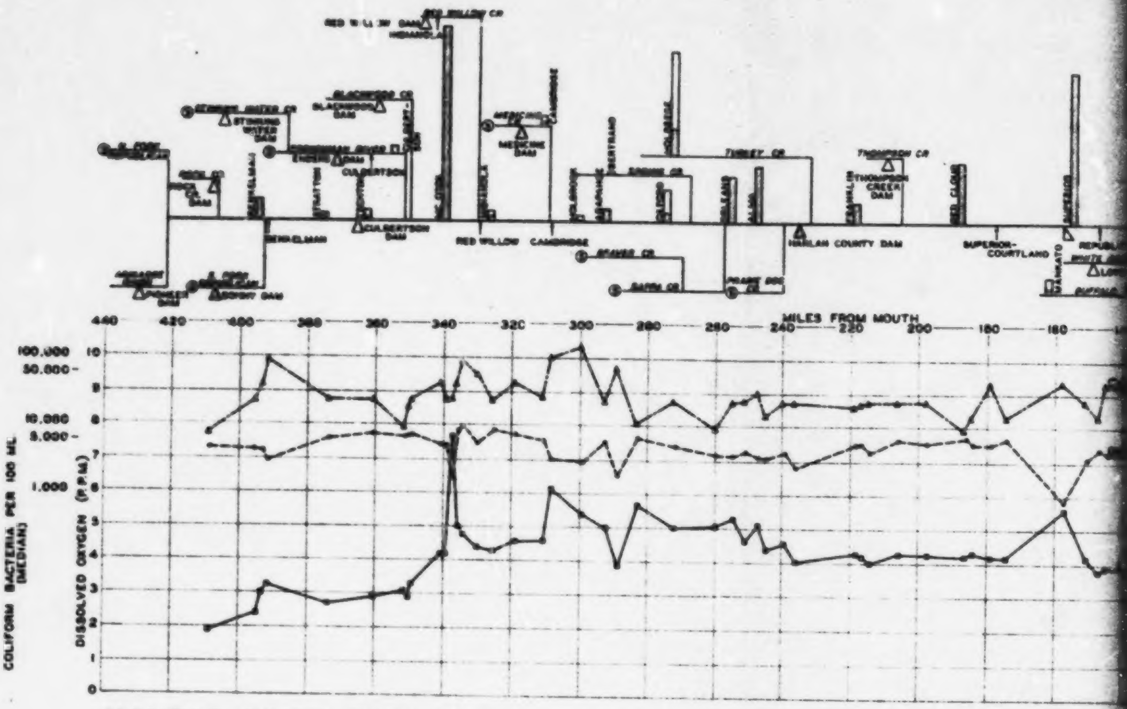
REPUBLICAN RIVER
SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS
SUMMER SEASON - 1948
(JUNE, JULY, AUG., SEPT.)

117-a



KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION

U.S. PUBLIC HEALTH SERVICE

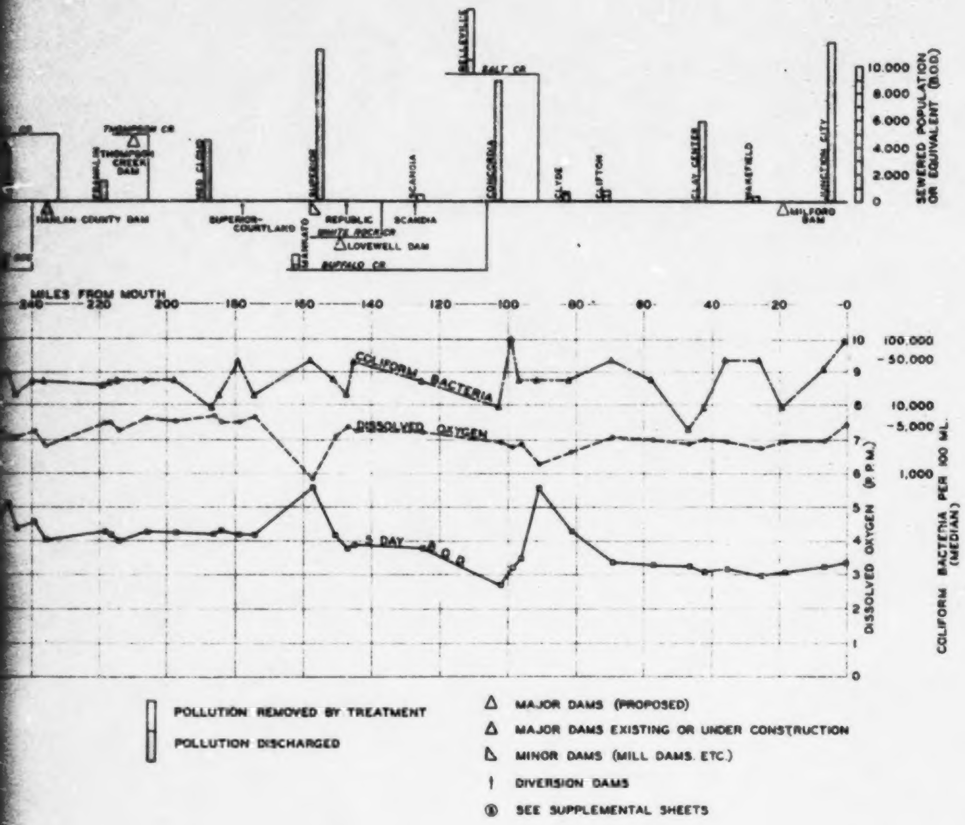
1949

▯ POLLUTION REMOVED BY TRE

▯ POLLUTION DISCHARGED

A

FIG. R-1



REPUBLICAN RIVER

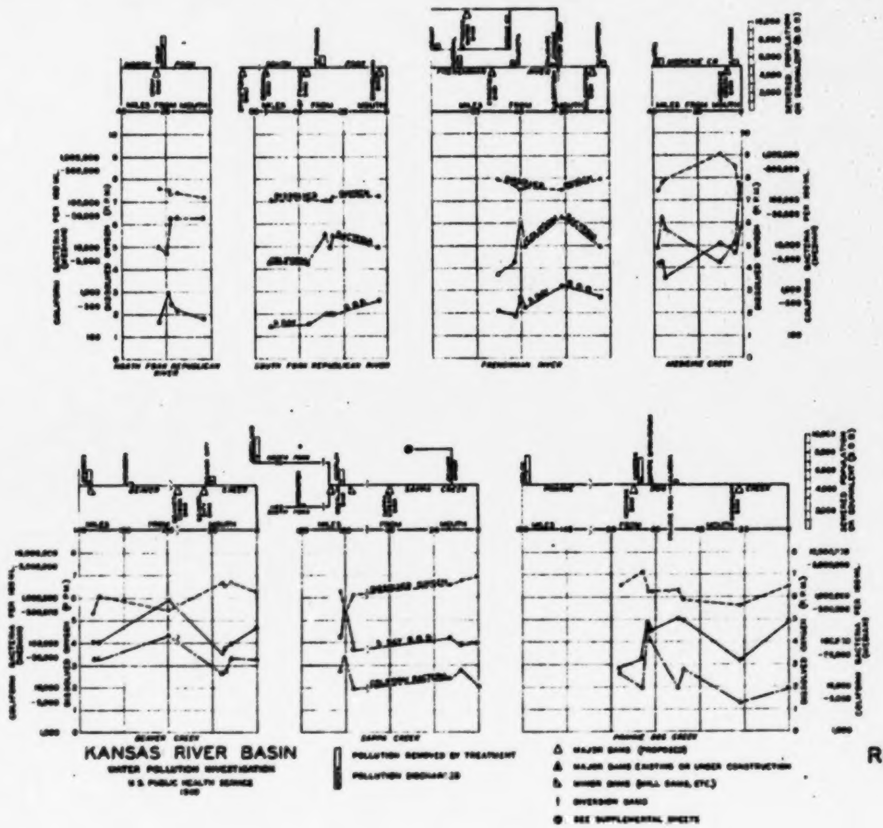
SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON-1948
(JUNE, JULY, AUG., SEPT.)

B

117-a

FIG. R-2



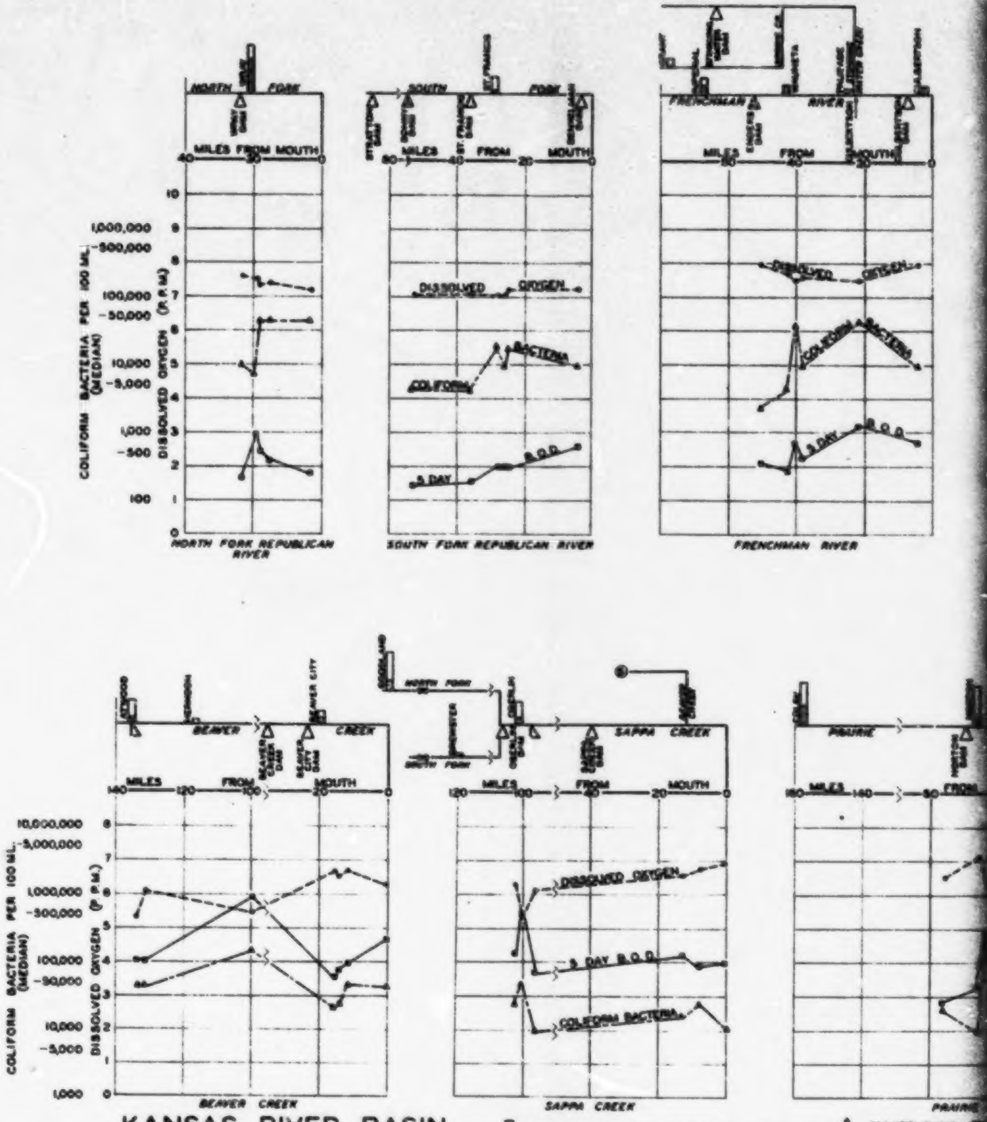
KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE
1949

XXXXXXXXXXXXXXXXXXXXXXXXX
See the following pages
for greater detail.
XXXXXXXXXXXXXXXXXXXXXXXXX

REPUBLICAN RIVER TRIBUTARIES

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON—1948
(JUNE, JULY, AUG., SEPT.)



KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION

U.S. PUBLIC HEALTH SERVICE
1949

POLLUTION REMOVED BY TREATMENT

POLLUTION DISCHARGED

△ MAJOR DAMS (P

▲ MAJOR DAMS EX

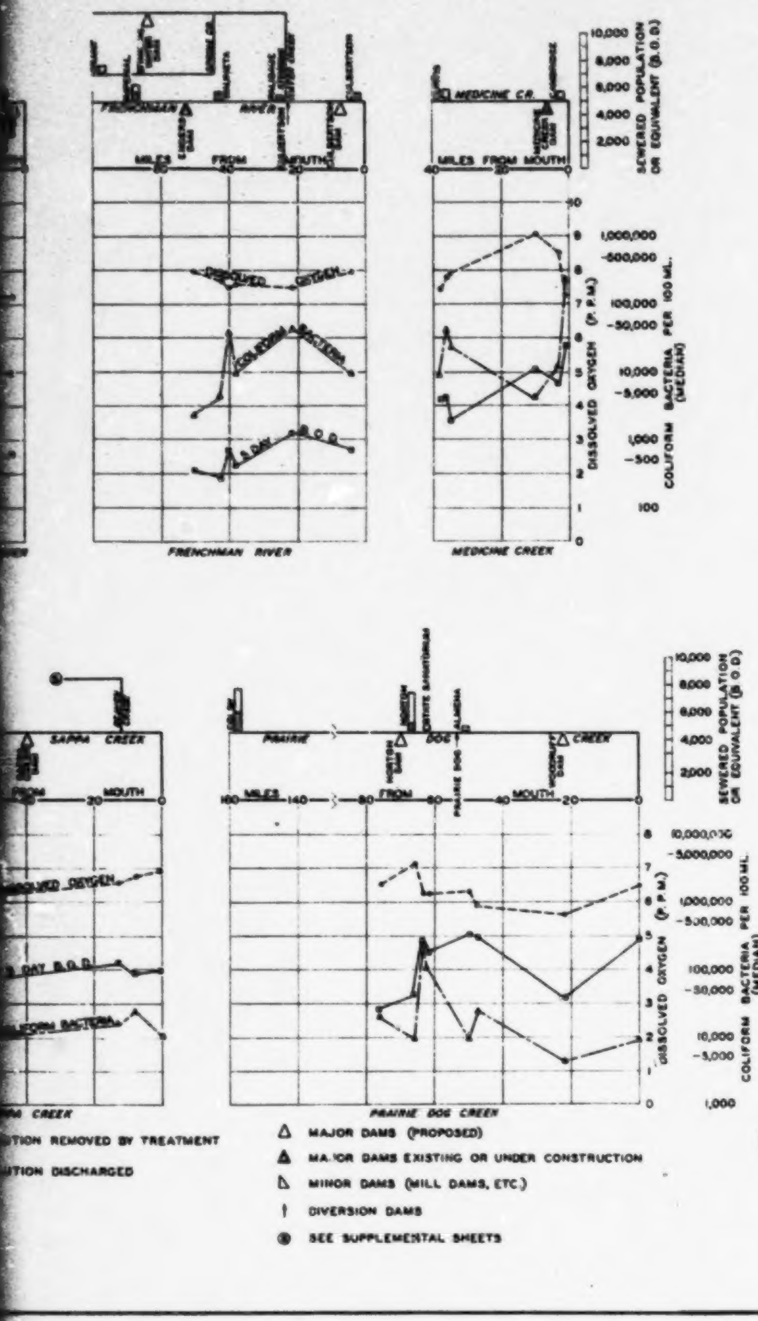
MINOR DAMS (

DIVERSION DAMS

● SEE SUPPLEMEN

A

FIG. R-2



REPUBLICAN RIVER TRIBUTARIES

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON - 1948
(JUNE, JULY, AUG., SEPT.)

B

117-6

B.O.D. exceeds the dissolved oxygen below McCook which discharges a comparatively high pollution load to the stream.

A fairly high B.O.D. level is maintained in the river reach McCook, Nebraska, to below Concordia, Kansas. Elsewhere average B.O.D. values of about 3.0 ppm were found.

Coliform bacteria generally fluctuate between the approximate median values of 10,000 and 100,000 M.P.N. per 100 ml indicating a fairly uniform high concentration.

Except on minor tributaries of the lower main stem, chloride values are quite low.

Principal Tributaries, Republican River - Average summer season dissolved oxygen, B.O.D., and median coliform results are shown on Figures 6, 7, and 8 and on Figure R-2. Average and maximum chloride data are shown on Figures 9 and 10.

Average summer dissolved oxygen values are uniformly in excess of 5 ppm and, with some exceptions, exceed the B.O.D. values. These exceptions are on Medicine Creek, below Cambridge, Nebraska; Beaver Creek, below Herndon, Kansas; and Sappa Creek, below Oberlin, Kansas, where B.O.D. values equal or exceed the dissolved oxygen.

Summer average B.O.D. concentrations range from less than 2 ppm to a maximum of about 6 ppm at a point about 100 miles from the mouth of Beaver Creek.

Median coliform bacteria numbers fluctuate widely and reach maxima in excess of 100,000 M.P.N. per 100 ml.

Chloride values are quite low.

DISCUSSION

In comparison with other sections of the country, the sources of pollution in the Republican River Basin are neither of very great magnitude nor of very great number. While in a number of places the discharge of untreated sewage and industrial wastes causes local nuisances and public health hazards, the distances between sources of pollution are appreciable. This leads to the expectation that the streams probably recover to a marked degree between sources of pollution. The laboratory data confirm this.

The correction of pollution problems in the Republican River Basin, and particularly the western portion of the Basin, is complicated by the fact that, during at least portions of all years, there is no flow whatever in many of the streams. This situation indicates that a high degree of sewage treatment will be required in most places to abate pollution. However, even with secondary treatment local pollution problems occur during the dry seasons below most of the cities located on the intermittent streams in the western portion of the Basin.

While surface water flows in the Republican River Basin are frequently very low for extended periods, it is apparent that ground water furnishes a generally reliable source of municipal supply, as evidenced by the fact that every municipality in the basin secures its public water supply from this source.

Sources of Pollution and Status of Sewage Treatment

As shown in Table R-6, there are 14 municipalities discharging raw sewage to streams in the Republican River Basin. These include some of the larger cities of the basin, notably Junction City, Clay Center, and Concordia, Kansas, and Superior, Nebraska. McCook, Nebraska has an ineffective septic tank plant so for all practical purposes it, too, is discharging raw sewage into the waters of the basin.

As indicated in Table R-6, there are 9 primary and septic tank treatment plants in the basin. The larger municipalities having such plants are Burlington and Wray, Colorado, and McCook and Benkelman,Nebraska. Seven of these are septic tank treatment plants which do not provide the 35 per cent B.O.D. removal usually credited to up-to-date primary treatment plants. For example, the septic tank plant at McCook fails to provide any effective reduction of the domestic and rather large industrial pollution load and consequently the sewered population equivalent discharged is shown in Table R-6 to be the same as the untreated sewered population equivalent.

Of the 24 secondary sewage treatment plants located in the Republican River Basin, five are located in municipalities of over 2,000 population; namely, Belleville, Norton, Colby and Goodland, Kansas, and Holdrege, Nebraska. In general, those cities located in the western Kansas portion of the basin where stream flow is deficient have provided satisfactory secondary treatment facilities.

Three of the four Colorado cities located in the Basin (Holyoke, Haxtun, Wray) have septic tank plants. The Holyoke sewage discharges to a lagoon in a dry creek bed and does not create a problem of other than possibly local importance. The Haxtun septic tank effluent is disposed of by land application. The partially treated Wray sewage is discharged into the North Fork of the Republican River shortly below the Wray dam site where it causes only a local pollution problem. Burlington, Colorado provides primary treatment;

but inasmuch as the plant effluent is used for irrigation purposes, no pollution load is imposed upon Beaver Creek.

Stream Conditions and Sewage Treatment Needs

Critical stream conditions occur just below McCook, Nebraska. Oxygen levels (summer season) below this city average fairly high but individual results showed serious oxygen deficiencies. Obviously a high degree of sewage treatment is needed at McCook. Similar though less serious problems will occur at low stream stages below Superior, Nebraska. This city discharges untreated sewage into the main river and needs a minimum of primary treatment.

To avoid local pollution problems other cities now discharging raw sewage into the waters of the basin should provide a minimum of efficient primary treatment. Major cities falling in this category are Orleans, Alma and Red Cloud, Nebraska, and Concordia, Clay Center and Junction City, Kansas. (A portion of the latter city's sewage is discharged to the Smoky Hill River.)

On the basis of unregulated stream flow, cities located in those portions of the basin where stream flow is intermittent or where low flows of normal expectancy are not adequate to handle the pollution load discharged after primary treatment, will need a minimum of efficient secondary treatment.

Flow Needs; Benefits and Damages

Where flow regulation providing increased flows of sufficient magnitude is available, a lower degree of sewage treatment than would otherwise be possible may be satisfactory as far as oxygen conditions in the stream are concerned. This would result in tangible monetary benefits assignable to the reservoirs involved. On the other hand, monetary damages to certain municipalities will result if the summer flow is reduced to too low a value as a result of diversion of water to other uses. In this connection it is not correct to assume that pollution damage will not be suffered as a consequence of regulation because the minimum flow subsequent to regulation can be maintained at a value about equal to the unregulated minimum formerly prevailing. Actually, under this kind of regulation the condition of the stream would be as bad as during previous times when the unregulated flow was at a minimum, and worse during additional times when the regulated flow is only as high as the previous minimum condition. In other terms, if the regulated flow is about equal to the normally expected unregulated minimum, but prevails at this level for longer periods of time, stream conditions will be as bad part of the time and worse during that part of the time when unregulated flows would have been at a higher level.

Flows classified as (1) "Useful Desirable" or (2) "Necessary to Prevent Damage to City" are given in Table R-10. These minimum monthly average flows were estimated on the following bases:

(a) Efficient primary treatment (35 per cent removal of biochemical oxygen demand) will be provided by all cities located on streams in question, except where cities already provide a higher degree of treatment due to local needs.

(b) Secondary treatment will be provided as necessary to correct pollution in tributary streams not subject to flow regulation. A minimum of primary treatment was assumed.

(c) Summer season water temperatures.

(d) A minimum of 5.0 ppm of dissolved oxygen in the stream below the source of pollution for flows classified as "Useful Desirable." Where minimum oxygen values of the past have been less than 5.0 ppm, flows classified as "Necessary to Prevent Damage to City" are based upon normally expected unregulated flows. In such cases a higher degree of treatment than primary has been needed in the past, consequently no damages are assignable unless regulated flows are appreciably less than normally expected unregulated flows.

Flows classified as "Secondary Treatment - Desirable Flows" are also given in Table R-10. These minimum monthly average flows were estimated on the following bases:

(a) Efficient secondary treatment (a minimum of 75 per cent removal of biochemical oxygen demand, B.O.D.) will be provided by all cities discharging into the main stream or its tributaries.

(b) Summer season water temperatures.

(c) A minimum of 5.0 ppm dissolved oxygen in the stream below sources of pollution.

These flows have been estimated to provide a basis for comparing the costs of a higher degree of treatment with the value of additional water which, because of this higher degree of treatment, would become available for irrigation diversion or other uses.

Tangible annual monetary pollution control benefits due to a lower required degree of sewage treatment resulting from the regulation program and assignable to flow regulation are indicated in

Table R-10

Republican River Basin

Flow Needs and Cost Evaluation

Community	Stream	Approximate Miles from Mouth		Normal	Useful Desirable Minimum (6)	Secondary Treatment Desirable Flows (7)	Necessary to Prevent Damage to City	Annual Tangible Monetary Benefits Possible if Flow in Column 6 is Provided	Preliminary Estimate: Minimum Mean Monthly Flow Under Proposed Flow Regulations Program	Annual Tangible Monetary Benefits (+) and Damages (-) Under Proposed Flow Regulation Program (Estimated Flow in Column 10)
		Republican	Tributary							
1	2	3	4	5	6	7	8	9	10	11
Wray, Colo	North Fork Republican River	421.7	19.5	15	11	5	11	0	25	0
St. Francis, Kans	South Fork Republican River	393.6	28.0	3(3)	2	2	2	0	8	0
Benkelman, Nebr	Republican River	393.5		2(1)	7	3	2	$ 1,700	-	-
Wauneta, Nebr	Frenchman River (Creek)	351.6	42.3	71(3)	4	2	4	0	-	-
Culbertson, Nebr	Frenchman River (Creek)	351.6	1.2	40(3)	4	2	4	0	-	-
McCook, Nebr	Republican River	339.3		-	50	20	-	13,600	35	+$ 10,200
Indianola, Nebr	Republican River	325.8		-	10	5	10	0	10	0
Cambridge, Nebr	Medicine Creek	309.6	0.8	42	3	3	3	0	-	-
Oberlin, Kans	Sappa Creek	258.0	100.8	2	2	2	2	0	-	-
Beaver City, Nebr	Beaver Creek	258.0	18.8	2	5	3	2	1,100	-	-
Orleans, Nebr	Republican River	255.0		28(3)	25	10	25	0	10	- 3,700
Norton, Kans	Prairie Dog Creek	239.8	66.0	2	2	2	2	0	-	-
Almena, Kans	Prairie Dog Creek	239.8	49.6	3(3)	2	2	2	0	-	-
Franklin, Nebr	Republican River	218.4		35(3)	8(5)	4(5)	8(5)	0	10	0
Red Cloud, Nebr	Republican River	186.7		45(3)	20	8	20	0	10	- 5,000
Superior, Nebr	Republican River	154.4		52(2)	40	18	40	0	10	- 11,000
Scandia, ~~Nebr~~ Kan.	Republican River	125.2		60(3)	30	15	30	0	10	- 600
Concordia, Kans	Republican River	102.4		100(3)	47	20	47	0	10	- 10,200
Clay Center, Kans	Republican River	42.1		205	33	15	33	0	39	0
Junction City, Kans	Republican River	4.2		210(3)	40	20	40	0	39(4)	0

1. Gaging station at Max, Nebr, Republican River Mile 385.6
2. Gaging station at Hardy, Nebr, Republican River Mile 145.1
3. Estimated
4. Flow reduction to figure indicated may cause downstream (Topeka and Lawrence) damages - See section on Main Kansas River
5. Based upon completion of Harlan County Dam
6. Based upon a dissolved oxygen objective of 5 ppm and primary treatment
7. Based upon a dissolved oxygen objective of 5 ppm and secondary treatment

Table R-10, Column 11, where they are applicable. In addition, Column 11 also presents the tangible annual monetary damages to various municipalities in the form of a higher required degree of treatment, on the basis of provision of the flows indicated in Column 10. For the method of deriving these benefit and damage figures see the introductory section of this report.

Flow needs during other seasons of the year will vary with water temperatures. Minimum monthly mean flows needed as a per cent of the summer season flows are given in Table R-11.

Republican River Compact

Reference is made to Appendix "G" - Republican River Compact, an agreement entered into by the States of Colorado, Kansas and Nebraska, with respect to the most beneficial use of waters of the Republican River Basin. The purpose of this compact, as worded in this document, is as follows: ". . . provide for the most efficient use of the waters of the Republican River Basin (hereinafter referred to as the 'Basin') for multiple purposes; to provide for an equitable division of such waters; to remove all causes, present and future, which might lead to controversies; to promote joint action by the States and the United States in the efficient use of water and the control of destructive floods."

This compact provides for the specific allocation in acre-feet of water to the various States in the Basin for beneficial consumptive use. Of considerable interest is the definition of the term "Beneficial Consumptive Use" as stated in this compact: "The term 'Beneficial Consumptive Use' is herein defined to be that use by which the water supply of the Basin is consumed through the activities of man, and shall include water consumed by evaporation from any reservoir, canal, ditch, or irrigated area."

Table R-11 - Republican River Basin - Minimum Monthly Mean Flows as a Per Cent of Summer Season Flows

Month	Approximate Water Temperature °F	°C	Desirable Flow as a Per Cent of Summer Season Flow
January	34	1	20
February	34	1	20
March	37	3	25
April	54	12	40
May	66	19	60
June	72	22	100
July	81	27	100
August	79	26	100
September	75	24	100
October	59	15	45
November	48	9	30
December	36	2	20

Effect of Reservoirs on Pollution Assimilation Capacity of the Streams

Substantial portions of what are now free-flowing streams in the Republican River Basin will be changed to nearly the equivalent of lakes by the construction of the numerous reservoirs planned. This will have varying effects on the pollution assimilation character of the streams and on water quality. A general discussion of this subject is presented in the introductory section of this report.

Effect of Reservoir Backwater

Backwater from Harlan County Dam will extend beyond Orleans, Nebraska and will affect either the public water supply or sewage discharge, or both, of Republican City, Alma and Orleans. As Republican City will be inundated, plans are underway to move this community to another site and to install a new water system and sewerage system with an adequate secondary treatment plant. The Alma water supply appears to be unaffected by the lake that will be formed behind Harlan County Dam although the sewage outfall will be submerged and Alma, in addition to sewage treatment, will be faced with the need of providing works necessary to pump the sewage into the ponded stream. The Nebraska State Department of Health, in view of local conditions and probable recreational developments in the area, has recommended secondary sewage treatment. If bathing areas are developed, the extra precaution of sewage effluent chlorination may be desirable during the warm season of the year. The City of Orleans is situated so that it will be in the upper reaches of the lake and its facilities apparently will be unaffected by backwater. However, ponding below the sewer outfall may necessitate a high degree of treatment of a secondary type. Location of recreational developments may indicate supplemental treatment as chlorination during portions of the year at this community.

A similar situation will probably be encountered at Wakefield, Kansas, above the Milford Dam.

Water Supply

Normally the prime consideration in any discussion of desirable stream flows is the matter of public water supply. The existence in the western portion of the Republican River Basin of a very valuable ground water supply makes the matter of supplying necessary water for municipal purposes of less importance. While rainfall in the area is small, the ground is porous and absorbs nearly all of the rainfall. In its downward flow the water is stopped by Cretaceous rocks, which prevent the water from sinking to great depths.

Kansas State Geological Survey Bulletin 41, published in 1942 and titled Ground-Water Supplies in Kansas Available for National Defense Industries, page 41, gives the following general information regarding ground water supplies in the lower portion of the Republican River Valley.

> "A few municipal and irrigation wells and many domestic and stock wells in the valley obtain abundant supplies of water. Properly constructed wells in favorable areas yield 500 to 1000 gallons a minute with nominal draw-down. Supplies as large as 5,000,000 gallons a day probably could be pumped from groups of wells in favorable areas of the Valley . . . . . .
>
> "The water from municipal wells at Concordia and Clay Center has a hardness of 316 to 524 parts per million (mostly carbonate hardness), and contains 1 to 2 parts of iron and 34 to 97 parts of chloride."

Although ground water supplies are generally adequate throughout the Basin, summer shortages have occurred at Mankato, Kansas, during the severe drouth of the thirties. Despite the general abundance of ground water, some municipalities and industries may find it necessary to develop surface water supplies in the future.

Public Water Supply Quality

In general, the mineral quality of the streams of this Basin is comparatively good. High chloride concentrations are not a problem except on a few minor tributaries. U. S. Geological Survey Water Supply Paper No. 273, titled Quality of the Water Supplies of Kansas (p. 232) states that the chloride concentration of the Republican River fluctuates considerably but is never very high. The same publication (p. 238) indicates that Buffalo Creek which enters the Republican River near Concordia, Kansas, is high in sulphate and chloride derived from salt springs and marshes in Vicksburg Township, Jewell County, Kansas, and from the Jamestown Marsh and the Little Marsh near Jamestown and Yuma, Kansas. These marshes and springs originate in the shales of the Dakota sandstone. Present results confirm these observations. Salt Creek which discharges to the Republican River several miles below Concordia and drains a salt marsh area to the north, also showed high chloride concentrations. However, if as a result of diversion of Republican River Basin water to irrigation use, there is a sharp reduction in the normal flows of the Kansas River, degradation of this stream's mineral quality will be a consequence. This will result from the fact that under this condition the flow from the Smoky Hill River which carries a nearly constant quantity (lbs. per sec.) of chloride would not be sufficiently diluted and result in higher than normal chloride concentrations at Topeka and Lawrence which use Kansas River water as a source of public water supply. Other objectionable mineral constituents such as calcium and magnesium, which cause hardness, might also be significantly increased.

The possible effects of growths of microscopic organisms in reservoirs on downstream water supplies is discussed in the introductory section.

Irrigation Water Quality

The public health significance of the use of sewage polluted water for irrigation purposes is worthy of careful consideration. Obviously, bacterial quality which has received only limited attention in this section because of lack of use of the surface waters of this Basin for public water supply takes on greater significance when viewed in the light of the rather extensive irrigation projects planned. The type of crops subjected to irrigation is also an important consideration from a public health standpoint. This general problem is discussed in the introductory section of this report and a partial review of the literature on the subject is given in Appendix "F".

SMOKY HILL RIVER BASIN

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SMOKY HILL RIVER BASIN

SYLLABUS

The Smoky Hill River has its source in eastern Colorado and flows eastward to its junction with the Republican River to form the Kansas River at Junction City, Kansas. Agriculture is the dominant activity in the area although considerable amounts of oil and gas are also produced. Two cities secure municipal water supplies from surface sources while the remainder utilize ground sources. Water supply problems and shortages have occurred at Russell and Hays, Kansas. Organic pollution on the Smoky Hill River below Salina has been a problem but a secondary sewage treatment plant is under construction by that city and will do much to relieve the situation. Mineral pollution from natural salt deposits and oil and gas field brine are of particular importance. Activity of the Kansas State Board of Health in connection with brine disposal has done much to control this type of pollution and the outlook is for continuing imporovement. Of the two dams planned, Kanapolis is completed and in operation and Cedar Bluff is under construction. Public water supply benefits at Hays and Russell might result from flow regulation or water storage by the Cedar Bluff project.

CONCLUSIONS

(1) There are two cities that obtain municipal water supplies from surface sources in the Smoky Hill River Basin. They supply a total population of 9,500 with an average of 0.86 million gallons per day.

(2) A total population of 56,303 in 33 municipalities in the Smoky Hill River Basin, is supplied with an average of 10.26 million gallons per day of water obtained from ground sources.

(3) Sewage from a population of 57,345, and industrial wastes equivalent to a sewered population of 20,990, are produced in the Smoky Hill River Basin. This total of 78,335 is reduced in municipal sewage treatment plants to a population equivalent of 46,469, or 41 per cent, before discharge to the Smoky Hill River and its tributaries. Approximately 95 per cent of the sewered population is connected to treatment plants. About 55 per cent of this population group is now served by primary sewage treatment. Completion of the Salina, Kansas, secondary sewage treatment plant will solve a major organic pollution problem in this basin.

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(4) Excluding the Salina problem, the general organic pollution picture presented by the laboratory data is one of only slight to moderate pollution on the main stem. Pollution problems of a local nature exist at points of raw sewage discharge on the seasonally dry upper reaches of the Smoky Hill River and on some of the tributaries. Wakeeney, Kansas, located on Big Creek, provides primary treatment only; a minimum of secondary treatment is indicated.

(5) The desirable summer season monthly mean discharge to provide adequate dilution of the Salina sewage after secondary treatment is approximately 47 c.f.s. As this is less than the reasonable minimum expected mean summer flows, no monetary benefits accrue to flow regulation for organic pollution control.

(6) Mineral quality, particularly the chloride concentration, of the streams in this basin is of dominant importance. Some of the high chloride load is derived from formation salt and some from oil field operations. Activities of the Kansas State Board of Health in connection with brine disposal have controlled the chloride increase and the outlook is for continuing improvement in brine disposal methods.

(7) Public water supply benefits at Hays and Russell might result from flow regulation of the Smoky Hill River by the Cedar Bluff reservoir. Any agency undertaking to control major surface water resources of the basin should consider the public water supply needs of the municipalities in the basin.

RESERVOIR PROJECTS

Table SH-1 presents summarized information on reservoir projects in accordance with information furnished by the Corps of Engineers. The Kanopolis Reservoir has a drainage area of 7,860 square miles, or 81 per cent of the 9,680 square miles of drainage area in the Smoky Hill River Basin excluding the Solomon and Saline Rivers. Cedar Bluff Reservoir, now under construction, is located 150.2 miles upstream from the Kanopolis Reservoir which is 207.8 river miles upstream from the mouth of the Smoky Hill River.

Table SH-1 Smoky Hill River Basin - Reservoir Data (1)

Reservoir	Tributary Stream	Miles to Mouth		Storage, Acre-Feet				Area Max. Pool Acres	Status
		Smoky Hill River	Tributary Stream	Silt and Conservation	Irrigation	Flood Control	Total		
Kanopolis	Smoky Hill	207.8		50,000	(2)	400,000	450,000		In (3) Operation
Cedar Bluff	Smoky Hill	358.0		53,600	118,600	180,000 (2)	352,200		Under Constr.

(1) Data from Corps of Engineers

(2) Flood-control storage in Cedar Bluff Reservoir will be allocated to replace equivalent storage allocation in the Kanopolis Reservoir. Storage thus made available in Kanopolis Reservoir may be used for irrigation purposes.

(3) Reservoir essentially completed and water is impounded.

DESCRIPTION

The Smoky Hill River rises in the eastern part of Colorado in Kit Carson and Cheyenne Counties and flows eastward approximately 560 river miles to its juncture with the Republican River just east of Junction City to form the Kansas River. A small part of the drainage area is in Colorado, while the major portion lies within Kansas. The drainage area of the Smoky Hill River, including the Saline and Solomon Rivers which discharge into the Smoky Hill, is 19,951 square miles. However, this section of the report includes a drainage area of only 9,680 square miles, which excludes the Solomon and Saline River drainage basin areas. The latter are covered in separate sections of the report.

Neither of the main headwater forks have perennial flow. In the western part of the Basin rainfall is low and evaporation high. However, there is some flow from seepage and springs from the Tertiary deposits. In the region where the main stream penetrates the Cretaceous formations, flow dries up at certain seasons because the Cretaceous formations with the exception of the Dakota sandstone are not waterbearing. East of Russell County where the rainfall increases and the stream flows in the Dakota sandstone, the river becomes perennial.

The rainfall in the Smoky Hill River Basin varies from approximately 17" per year in the western end to about 31" in the eastern section. The principal tributaries of the Smoky Hill River of interest in this survey are as shown in Table SH-2.

Table SH-2 - Smoky Hill River Basin - Principal Tributaries

Tributary	Miles Above Mouth Main Stem	 Tributaries	Drainage Area Square Miles
Smoky Hill River (Mile 169.2 - Kansas River)			19,951
Solomon River	85.4		6,846
North Fork Solomon River		171.6	2,718
South Fork Solomon River		171.6	2,260
Saline River	106.5		3,425
Big Creek	292.1		783
Hackberry Creek	378.2		747
Beaver (Ladder) Creek	431.1		1,463

Table SH-3 lists 37 municipalities in the Smoky Hill River Basin excluding the cities contained in the drainage areas of the Solomon and Saline Rivers. Eleven of these (U.S. Census 1940) have

Table SH-3

Smoky Hill River Basin

Population of Cities

City	Population - U. S. Census			
	1920	1930	1940	1948*
Abilene, Kansas	4,895	5,658	5,671	5,882
Assaria, Kansas	234	201	232	228
Bunker Hill, Kansas	268	298	253	228
Chapman, Kansas	853	819	782	874
Collyer, Kansas	190	243	268	268
Ellis, Kansas	1,876	1,957	2,042	2,006
Ellsworth, Kansas	2,065	2,072	2,227	2,203
Enterprise, Kansas	975	764	671	808
Gove, Kansas	132	241	284	210
Grainfield, Kansas	290	343	341	301
Grinnell, Kansas	162	303	289	345
Gypsum, Kansas	732	638	615	602
Hays, Kansas	3,165	4,618	6,385	7,205
Herington, Kansas	4,065	4,519	3,804	3,711
Hope, Kansas	589	556	500	509
Kanopolis, Kansas	762	860	868	891
Lindsborg, Kansas	1,897	2,016	1,913	2,196
Longford, Kansas	155	200	180	181
McCracken, Kansas	491	594	534	504
Manchester, Kansas	263	241	215	159
Marquette, Kansas	780	714	609	745
Miltonvale, Kansas	821	814	800	808
Oakley, Kansas	768	1,159	1,138	1,652
Quinter, Kansas	383	570	481	643
Russell, Kansas	1,700	2,352	4,819	5,516
Salina, Kansas	15,085	20,155	21,073	26,222
Schoenchen, Kansas	-	-	259	197
Sharon Springs, Kansas	815	792	760	982
Solomon, Kansas	1,071	1,032	372	910
Utica, Kansas	285	382	379	367
Victoria, Kansas	600	637	884	909
Wakeeney, Kansas	1,003	1,406	1,852	2,095
Wallace, Kansas	-	-	102	94
Wilson, Kansas	1,020	1,038	1,068	1,121
Winona, Kansas	-	324	317	317
Woodbine, Kansas	318	317	212	214
Cheyenne Wells, Colorado	508	595	695	800

* Estimated

Kansas populations from Kansas State Board of Agriculture Bulletin "Population of Kansas" August 24, 1948.

populations greater than 1,000. The 4 principal cities and their 1940 populations are: Abilene 5,671; Hays 6,385; Russell 4,819; and Salina 21,073. One city, Cheyenne Wells, population 695, is located in Colorado; the remaining 36 are in Kansas. The principal activities in the Basin are those associated with agriculture and oil production.

PRESENTATION OF DATA

Public Water Supplies

There are two municipalities that obtain water from surface sources in the Smoky Hill River Basin (Table SH-4).

Table SH-4 - Smoky Hill River Basin
Municipal Surface Water Supplies

Stream and Municipality	State	Miles Above Mouth: Smoky Hill River	Miles Above Mouth: Tributary	Treatment (1)	Population Served	Average Consumption M.G.D.
Smoky Hill River						
Lyons Creek		14.0				
Herington	Kans		37.0	FD	3,700	0.40
Fossil Creek		284.0				
Russell (2)	Kans		7.0	FDH	5,800	0.46
Total					9,500	0.86

(1) F - Coagulated, settled, filtered
H - Softened
D - Chlorinated

(2) Russell obtains water from Big Creek and an impoundment on Fossil Creek

Herington, near Lyons Creek, supplies 3,700 people with an average of 0.4 million gallons per day. Russell, north of Mile 289 on the Smoky Hill River, supplies 5,800 people with an average of 0.46 million gallons per day obtained from an impoundment on Fossil Creek and from Big Creek, tributaries of the Smoky Hill River.

Table SH-5 lists 33 municipalities that obtain water supplies from ground sources in the Smoky Hill River Basin. These supply a total population of 56,303 with an average of 10.26 million gallons

Table SH-5 Smoky Hill River Basin

Municipal Water Supplies From Ground Sources

Municipality	State	Source (1)	Treatment (2)	Population Served	Average Consumption M. G. D.
Abilene	Kans	SW	D	5,600	1.12
Assaria	Kans	SW	N	210	0.02
Bunker Hill	Kans	DW	N	180	0.02
Chapman	Kans	SW	D	850	0.10
Collyer	Kans	DW	N	160	0.03
Ellis	Kans	SW	Dp	1,840	0.30
Ellsworth	Kans	SW	Dp	2,200	0.40
Enterprise	Kans	SW	DH	810	0.10
Gove	Kans	SW	N	24	0.01
Grainfield	Kans	DW	N	190	0.03
Grinnell	Kans	DW	N	210	0.01
Gypsum	Kans	SW	N	550	0.03
Hays	Kans	SW	Dp	6,400	0.75
Hope	Kans	SW	N	320	0.02
Kanopolis	Kans	SW	Dp	670	0.03
Lindsborg	Kans	SW	N	1,900	0.30
Longford	Kans	DW,SW	N	120	0.01
McCracken	Kans	SW	Dp	480	0.04
Manchester	Kans	SW	N	140	0.01
Marquette	Kans	SW	N	600	0.06
Miltonvale	Kans	SW	N	700	0.07
Oakley	Kans	DW	N	1,650	0.40
Quinter	Kans	DW	N	560	0.04
Salina	Kans	SW	D	23,000	5.50
Sharon Springs	Kans	SW	D	980	0.16
Solomon	Kans	SW	N	789	0.04
Utica	Kans	SW,DW	N	310	0.03
Victoria	Kans	SW	N	600	0.03
Wakeeney	Kans	SW	D	1,800	0.25
Wallace	Kans	SW	N	110	0.01
Wilson	Kans	SW	D	1,180	0.21
Winona	Kans	SW	N	320	0.01
Cheyenne Wells	Colo	DW	N	850	0.12
	Total			56,303	10.26

(1) Source -
Sp - Springs
SW - Shallow Wells
DW - Deep Wells

(2) Treatment -
N - None
D - Chlorinated
Dp - Partially Chlorinated
H - Softened

per day. Ground water is abundant in many localities in the eastern half of the Smoky Hill River Valley, particularly east of Ellsworth County.

Sources of Pollution

Table SH-6 summarizes the location and magnitude of significant sources of organic pollution, including data on sewered industrial wastes discharged to streams of the Smoky Hill River. As noted in this table, the population connected to sewers is 57,345. The sewered population equivalent of industrial wastes is 20,990, or a total sewered population equivalent of 78,335. This is reduced by treatment so that sewage from a population equivalent of 46,469 is discharged to the Smoky Hill and its tributaries. This is an average over-all reduction of 41 per cent.

There are 9 municipalities having a sewered population equivalent of 30,640, or 39 per cent of the total, that have secondary sewage treatment plants. These plants provide an average over-all reduction of 78 per cent.

Salina, which has an overloaded primary treatment plant, produces a sewered population equivalent of 34,500, or 44 per cent of the total. The effluent from this plant is reduced to a sewered population equivalent of 31,100, or only about 10 per cent reduction. However, Salina now has under construction a new secondary treatment plant which if properly maintained and operated should reduce the pollution load from this City by at least 80%.

The four towns that have no treatment plants discharge a population equivalent of 3,345, or 7.2 per cent of the total, to the Smoky Hill River and its tributaries.

The principal sources of organic pollution, from communities providing treatment, excluding Salina, are Abilene, Hays, Ellis and Wakeeney, with sewered population equivalents after treatment of 4,050, 2,320, 1,095 and 1,200 respectively. The towns of Chapman, Enterprise, Solomon, and Marquette discharge raw sewage having respective sewered population equivalents of 1,100, 650, 750 and 845. Even though these are relatively small towns, the discharge of raw sewage undoubtedly presents a local health hazard on the Smoky Hill irrespective of the flow.

An additional significant type of pollution in this basin is the brine pumped to the ground surface as a result of the rather extensive crude oil production operations in this basin. This is discussed briefly later in this section of the report and in detail in Appendix "C".

Table SH-6

Smoky Hill River Basin

Sources of Pollution Including Industrial Wastes Expressed as Sewered Population Equivalent (B.O.D.)

Municipality	State	Miles Above Mouth Smoky Hill River	Miles Above Mouth Tributary	Population Connected to Sewers	Treatment (1)	Sewered Population Equivalent (B.O.D.) Untreated	Sewered Population Equivalent (B.O.D.) Discharged
Smoky Hill River							
Lyons Creek		14.0					
Herington	Kans		37.0	3,150	S	3,520	260
Chapman	Kans	37.8		830	N	1,100	1,100
Enterprise	Kans	55.4		650	N	650	650
Abilene	Kans	64.8		5,000	P	8,100	4,050
Solomon	Kans	85.3		750	N	750	750
Salina	Kans	123.5		25,000	P	34,500	31,100
Lindsborg	Kans	167.4		1,900	S	2,080	520
Marquette	Kans	192.5		665	N	845	845
Ellsworth	Kans	238.3		1,650	S	2,040	510
Wilson	Kans	258.0		700	S	2,050	510
Fossil Creek		282.1					
Russell	Kans		4.5	5,000	S	5,240	524
Big Creek		292.1					
Hays	Kans		25.0	6,400	S	7,810	2,320
Ellis	Kans		44.0	1,840	S	4,380	1,095
Wakeeney	Kans		80.0	1,500	P	1,500	1,200
Hackberry Creek		378.2					
Oakley	Kans		60.0	1,350	S	1,610	400
Sharon Springs	Kans	501.0		710	S	1,910	475
Cheyenne Wells	Colo	542.0		250	P	250	160(2)
Total				57,345		68,335	46,469

(1) Treatment - N - None
S - Secondary
P - Primary

(2) Discharges to dry wash

Laboratory Results

Average or median summer season laboratory results are presented in Figures 6, 7, 8, 9 and in Figure SH-1. The laboratory data confirm the information previously presented on sources of organic pollution; i. e., the most serious problem is below Salina. The need for additional sewage treatment at Salina is evident from data presented. Fortunately this need is now in the process of being met by the construction of a secondary sewage treatment plant which should reduce the pollution load a minimum of 80%.

Excluding the Salina problem, the general picture given by the laboratory data is one of only slight to moderate pollution. Dissolved oxygen values are far in excess of the B.O.D. and median coliform concentrations are not great.

Individual laboratory results and corresponding flow data are presented in Appendix "H".

The chloride problem dominates water quality considerations in this basin. This is graphically portrayed in Figures 9 and 10, and in Figure I of Appendix "C".

Low-Flow Frequencies

A brief study of the low-flow frequency by months has been made during the period of record. A summary of the results appears in Tables SH-7 and SH-8.

Consideration of low-flows is important in a stream pollution study because it gives an indication of the frequency with which objectionable low flows have occurred in the past. The lowest monthly flow during the summer (June-September, inclusive) or winter (December-February, inclusive) of the period under consideration was used in computing the low monthly flow frequency.

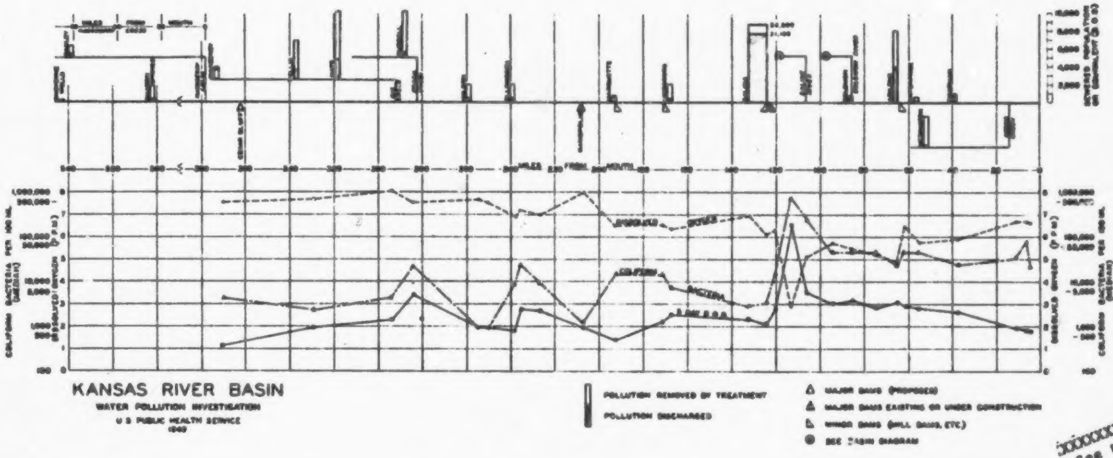
Low summer flows are important because higher temperatures reduce oxygen solubility in water and increase the rate of biological oxygen utilization. Low winter flows are especially important where consideration is given to winter storage for subsequent irrigation usage. Knowledge of low winter flow requirements allows minimum diversion for dilution and other purposes and enables maximum storage for irrigation the following season.

DISCUSSION

Stream Pollution

Generally speaking, organic pollution of the Smoky Hill River

FIG. SH-1



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
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1949

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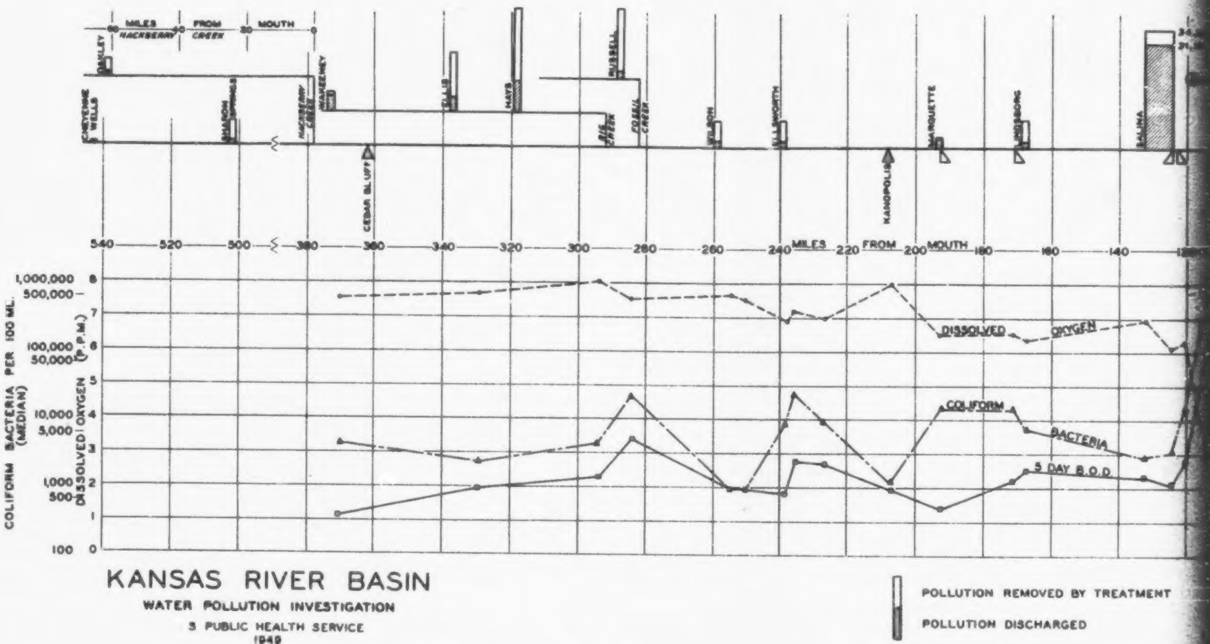
See the following pages
for greater detail.
XXXXXXXXXXXXXXXXXXXXXXXXX

SMOKY HILL RIVER

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON - 1948
(JUNE, JULY, AUG., SEPT)

139-a



KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION

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1949

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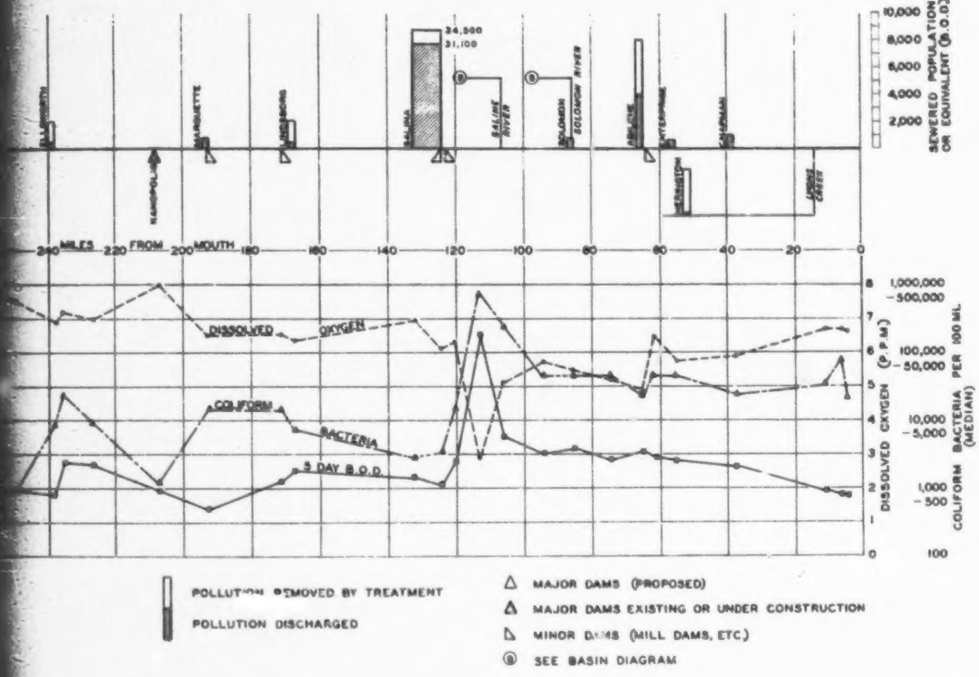
FIG. SH-1



SMOKY HILL RIVER

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON - 1946
(JUNE, JULY, AUG., SEPT.)

B

Table SH-7

Smoky Hill River Basin

Frequency of Low Mean Monthly Summer (June - Sept) Discharges

Years of Record	Stream and Location	Miles to Mouth: Smoky Hill River	Miles to Mouth: Tributary	Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in: 2 years	3 years	5 years	10 years	Minimum*
	Smoky Hill River								
27	Salina, Kans	124.0		8,243	112	70	48	27	15
27	Lindsborg, Kans	170.9		8,112	100	62	31	21	12
27	Marquette, Kans	192.4		7,953	89	45	27	18	12

Table SH-8

Smoky Hill River Basin

Frequency of Low Mean Monthly Winter (Dec - Feb) Discharges

Years of Record	Stream and Location	Miles to Mouth: Smoky Hill River	Miles to Mouth: Tributary	Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in: 2 years	3 years	5 years	10 years	Minimum*
	Smoky Hill River								
26	Salina, Kans	124.0		8,243	50	30	27	20	15
26	Lindsborg, Kans	170.9		8,112	36	24	20	13	10
26	Marquette, Kans	192.4		7,953	35	22	17	11	6

* Low Mean Month

is not very great when compared to other streams in the country but somewhat greater than the pollution of the Solomon and Saline Rivers. The pollution load is of such magnitude and distributed along the main stream in such a manner that there is considerable recovery in the stream between points of pollution.

Fortunately, only five towns discharge sewage into the upper reaches of the river and its tributaries where periodic drying up causes local pollution problems. The cities of Hays, Ellis and Wakeeney discharge sewage into Big Creek which flows into the Smoky Hill at River Mile 292.1. Part of the Russell, Kansas, city water supply is obtained from Big Creek. Data collected during this survey did not indicate excessive pollution reaching the Russell Water works intake on Big Creek. However, water treatment is undoubtedly rendered more difficult and expensive because of the sewage pollution of this stream. Taste and odor has been a recurring problem at Russell.

Wakeeney now provides only primary treatment. Secondary treatment is a necessity for this city. Although Sharon Springs has a secondary treatment plant local pollution problems occur during seasons when the flow in the stream consists principally of sewage treatment plant effluent.

Local nuisance and health hazards probably exist below the cities of Chapman, Enterprise, Solomon and Marquette, all of which discharge raw sewage into the Smoky Hill River, even though the pollution load contributed by these small communities is not great.

The city of Herington, Kansas, located near Lyons Creek, a small tributary of the Smoky Hill, sells the effluent of its sewage treatment plant to a railroad for use as boiler water.

In the past rather serious pollution has existed in Fossil Creek below the Russell sewage treatment plant. This was principally due to faulty plant maintenance and operation during the war years and these deficiencies have now been corrected. However, during seasons when the flow of the creek is almost entirely treated sewage,health hazards and minor nuisances may still exist.

The pollution situation below Salina is now being corrected by the construction of a secondary sewage treatment plant which if properly maintained and operated will reduce the pollution load from this city by 80 per cent. The desirable summer season monthly mean flow to provide dilution of the city's sewage after removal of 80 per cent of the pollution load is about 47 c.f.s. This appears lower than what might be termed a reasonable minimum monthly mean summer flow and no organic pollution monetary benefits can be assigned to flow regulation provided by upstream reservoirs. Flows during other seasons of the year are a function of the stream temperature and vary approximately as shown on Table SH- 9.

Table SH-9 - Smoky Hill River Basin - Seasonal Variations of Desirable Minimum Monthly Mean Flow

Month	Approximate Average Stream Temperature °C	Approximate Average Stream Temperature °F	Minimum Monthly Mean Flow as % of Summer Season Flow
January	1	34	20
February	1	34	20
March	3	37	25
April	12	54	40
May	19	66	60
June	22	72	100
July	27	81	100
August	26	79	100
September	24	75	100
October	15	59	45
November	9	48	30
December	2	36	20

Desirable winter discharge requirements are also less than the normal monthly mean winter expectancies.

Mineral quality of the streams of the Smoky Hill Basin is of dominant importance. Chloride, sulfate and hardness are frequently excessive. High hardness and sometimes high sulfate are associated with high chloride. Some of the high chloride load carried by this stream and its tributaries is undoubtedly derived from natural salt formations. Data collected by the U. S. Geological Survey prior to the discovery of oil in this basin showed high chloride in the stream. This early report (U. S. Geological Survey Water Supply Paper 273) also mentioned, ".....the operation of the salt works at Ellsworth and Kanopolis, where great salt deposits in the Permian are worked." However, a part is contributed by waste brine produced from the extensive oil fields located in this basin. Of particular importance, in this connection, are the oil field areas discovered and developed prior to the organization of the Oil Field Section of the Kansas State Board of Health. This state department's pioneer activities in the field of oil brine disposal have resulted in the development of satisfactory sub-surface disposal methods for these brines and have undoubtedly checked the chloride increase in the stream from this source. The outlook is one of continued activity and improvement in oil brine disposal methods.

Water Supply

There is urgent need for careful control and conservation of the water resources of the basin so that the best consumptive use - domestic, industrial and agricultural-can be realized of the limited supply available. The proper development and utilization of this resource are essential to the future progress of the basin. In view of the limited quantity and, in some instances, poor quality of the basin water supplies, the dollar value of water is higher here than in many other sections of the country.

In the past, Russell, Kansas, has suffered rather serious water shortages during dry seasons. In addition, the quality of the Russell city water supply has, at times, been extremely unsatisfactory because of its high chloride content especially during seasons of low stream discharge. Since chloride cannot be removed by water treatment methods suited to municipal use, a great hardship has been created at Russell.

The City has considered the construction of a pipe line southwest to the Smoky Hill River near Pfeifer (SH-314.8) to obtain a supplementary water supply of fairly good mineral quality. Improvement in the mineral quality of the stream could be effected by low flow regulation from storage provided in Cedar Bluff Reservoir. Utilization of the Smoky Hill River as a supplementary water supply would require the construction by the city of suitable intake and conduit works plus possible additional storage. The value of reservoir regulation would be fairly represented by the difference between the annual charges for the works necessary to provide water of comparable quality by some other means and the annual charges for the works required to utilize the regulated flow of the river.

The City of Hays, Kansas, like Russell, has suffered periodic water shortages although chloride has not been a problem. The City constructed a large number of shallow wells but the ground water supply near Hays has not always been adequate. The possibility of developing a surface water supply has been considered informally by Hays. The obvious source was the Smoky Hill River. If a surface supply for Hays is developed on this stream, regulation of flow for the benefit of Russell would also benefit Hays. Some high chloride concentrations are reported above River Mile SH-320, which is approximately south of Hays and regulation would tend to reduce these peaks. Regulation would also allow the construction of smaller and less expensive impoundment works than would otherwise be required.

Other possible methods of utilizing the reservoir at Cedar Bluff Dam to alleviate water supply problems at Hays and Russell should be explored. It may be observed (Fig. 2) that planned irrigation canals from Cedar Bluff Reservoir may extend eastward to a point generally south of Hays. This may provide a means of supplying the cities of Hays and Russell with water of good chemical quality obtained from the reservoir. Of course, a water treatment plant would be necessary. Securing water from the reservoir and conveying it directly to the areas where needed would be the most satisfactory method and permit consumption with a minimum of treatment. Cognizance is taken of the fact that long distances are involved making such an undertaking extremely expensive. Yet, the possibility of the establishment of a water district serving Hays and Russell and possibly other communities should not be entirely neglected.

Utilization of water from the reservoir for municipal consumption would result in considerable cost benefit credited to the dam.

Agencies undertaking the control of major surface water resources of the basin should take cognizance of possible public water supply needs of cities in the basin.

SOLOMON RIVER BASIN

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SOLOMON RIVER BASIN

SYLLABUS

The headwaters of the Solomon River are in northwestern Kansas. The river flows generally southeastward to its confluence with the Smoky Hill River above Abilene, Kansas. Agriculture is the mainstay of the region's economy. Two cities utilize surface streams for sources of public water supply. The most critical pollution problems are on the Main Stem in the Beloit-Glasco-Minneapolis reach. Three dams have been authorized but none are under construction. Flow stabilization and regulation by these reservoirs will have an influence on the surface water supplies. Normal unregulated stream flows, in general, are adequate for stream sanitation needs provided municipal sewage receives a minimum of primary treatment.

CONCLUSIONS

(1) Two Kansas municipalities - Beloit and Osborne - obtain surface water supplies from the Solomon River and tributaries and supply a total population of 6,060 with an average of 0.53 million gallons per day. Both of these supplies are below authorized reservoir locations.

(2) Thirty-one public water supplies in the Solomon River Basin are obtained from underground sources and furnish a total population of 20,262 with an average of 3.14 million gallons per day.

(3) Sewage from a population of 16,660 and industrial waste equivalent to a sewered population of 5,405, or a total population equivalent of 22,065 are produced in the Solomon River Basin. This is reduced by treatment to 16,385, or a reduction of 26 per cent. Sixty-five per cent of the sewered population is supplied with sewage treatment facilities, but not all of the facilities are efficient in reducing the pollution load. Beloit, Glasco and Minneapolis, Kansas, have no treatment.

(4) A minimum of primary treatment is needed at Beloit, Glasco and Minneapolis. This also applies to Downs and Osborne which now provide less than the equivalent of primary treatment.

(5) Pollution from Phillipsburg's treatment plant and the nearby industry reaches Deer Creek only during high water periods and should be evaluated by State and local authorities in terms of the local pollution problem and the hazard of pollution "slugs".

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(6) Desirable minimum monthly mean summer flows below Beloit are 24 c.f.s. based on primary treatment at Beloit, Glasco and Minneapolis and no net water loss due to irrigation diversions below this point. The unregulated summer season mean flows usually exceed this value. Unregulated winter mean flows are normally adequate.

(7) Desirable summer season, minimum monthly mean flows below Osborne on the South Fork and Downs on the North Fork are about 10 c.f.s., assuming primary treatment of sewage at these cities. Unregulated summer season mean flows generally exceed this discharge value. Unregulated winter mean flows are normally sufficient.

(8) Flow regulation by Glen Elder, Kirwin and Webster reservoirs will improve the mineral quality of the Osborne and Beloit public water supplies (particularly the latter) during the normal low flow seasons. Water supply taste and odor problems may be rendered more difficult due to algae growths in the reservoirs.

Mineral quality benefits will extend to surface water supplies located further downstream in the Kansas River Basin.

(9) Excessive chloride concentrations are not a serious problem in this basin although high chloride values are found in the lower portion of the main stem and its tributaries. The principal source of this chloride is naturally occurring salt marshes and springs. Authorized reservoirs are located above the principal chloride sources.

RESERVOIR PROJECTS

Table S-1 presents summarized information on reservoir projects in accordance with information furnished by the Bureau of Reclamation and Corps of Engineers. All three of these reservoirs are authorized but none is under construction. Glen Elder, the largest of these has a drainage area, including the drainage area of both Kirwin and Webster reservoirs which are upstream from Glen Elder, of 5,076 square miles, or 74 per cent of the total area of the Solomon River Basin.

Table S-1 Solomon River Basin - Reservoir Data (1)

Reservoir	Tributary Stream	Miles to Mouth		Storage, Acre-Feet				Area Max. Pool Acres	Status
		Solomon River	Tributary Stream	Silt and Conservation	Irrigation	Flood Control	Total		
Glen Elder	Solomon River	156.1		25,000	171,000	183,000	379,000		Authorized
Kirwin	N. Fork Solomon River	171.6	66.6	15,000	80,000	105,000	200,000		Authorized
Webster (2)	S. Fork Solomon River	171.6	89.8	11,000	150,000	94,000	255,000		Authorized

(1) Data from Corps of Engineers.

(2) Alternate site being investigated by the Bureau of Reclamation.

DESCRIPTION

The main stem of the Solomon River is about 172 miles long from its headwaters at the junction of the North Fork and South Fork of the Solomon River to its mouth at Solomon, Kansas, where it joins the Smoky Hill River. The basin has a drainage area of 6,846 square miles.

The principal tributaries of the Solomon River of interest in this survey are shown in Table S-2.

Table S-2 - Solomon River Basin - Principal Tributaries

Tributary	Miles Above Solomon River Mouth	Drainage Area, Square Miles
Salt Creek	48.0	449
Hermes Creek	155.3	213
North Fork of Solomon River	171.6	2,718
South Fork of Solomon River	171.6	2,260

The North and South Forks rise in the northwestern part of Kansas about 35 miles from both the Colorado and Nebraska state lines and are separated from each other by about 10 miles. They flow generally eastward about 225 river miles to join just south of Cawker City to form the Solomon which flows in a southeasterly direction to the Smoky Hill River. The upper reaches of these forks are dry during the greater part of the year because they lie in a deficient rainfall region (19" - 21" per year) and because they have not cut deep enough into the Tertiary deposits to tap the underground water of these deposits.

Table S-3 lists 35 municipalities in the Solomon River Basin. Only ten of these have populations over 1,000 and only two, Beloit and Phillipsburg, have populations over 2,500. The principal activities in the Basin are those relating to agriculture.

PRESENTATION OF DATA

Public Water Supplies

There are two municipalities that obtain water from surface sources in the Solomon Basin, as shown in Table S-4. Beloit, on the Solomon River, supplies 4,260 people with an average of 0.33

Table S-3 Solomon River Basin

Population of Cities

City	Population - U. S. Census			
	1920	1930	1940	1948*
Agra, Kansas	361	408	406	436
Alton, Kansas	423	383	435	324
Athol, Kansas	294	280	248	224
Barnard, Kansas	359	416	306	298
Beloit, Kansas	3,315	3,502	3,765	3,938
Bennington, Kansas	371	374	369	351
Bogue, Kansas	-	-	157	227
Cawker City, Kansas	788	739	657	688
Damar, Kansas	-	-	265	269
Delphos, Kansas	870	678	714	676
Downs, Kansas	1,508	1,383	1,219	1,245
Esbon, Kansas	375	319	292	279
Gaylord, Kansas	356	291	245	253
Glasco, Kansas	724	707	741	759
Glen Elder, Kansas	615	617	555	575
Hill City, Kansas	732	1,027	1,115	1,258
Hoxie, Kansas	616	800	957	1,090
Kensington, Kansas	595	546	597	610
Kirwin, Kansas	553	500	392	400
Lebanon, Kansas	822	723	652	562
Lenora, Kansas	520	519	537	546
Logan, Kansas	585	743	703	1,055
Minneapolis, Kansas	1,842	1,741	2,087	2,057
Moreland, Kansas	296	385	356	286
Osborne, Kansas	1,635	1,881	1,876	1,937
Palco, Kansas	281	290	276	296
Phillipsburg, Kansas	1,310	1,543	2,109	2,599
Portis, Kansas	390	340	349	277
Prairie View, Kansas	183	198	205	226
Simpson, Kansas	295	273	235	223
Smith Center, Kansas	1,567	1,736	1,686	1,933
Speed, Kansas	-	139	111	119
Stockton, Kansas	1,324	1,291	1,418	1,853
Tipton, Kansas	230	294	248	249
Woodston, Kansas	314	287	286	293

* Estimated

Kansas State Board of Agriculture Bulletin
"Population of Kansas" August 24, 1948.

million gallons per day. Osborne, at Mile 26.1 on the South Fork of the Solomon, supplies 1,800 people with an average of 0.20 million gallons per day from both ground and surface sources.

Table S-4 - Solomon River Basin - Municipal Surface Water Supplies

Stream and Municipality	State	Miles above Mouth		Treatment (1)	Population Served	Average Consumption M.G.D.
		Solomon River	Tributary			
Solomon River						
Beloit	Kans	130.6		FDH	4,260	0.33
S. Fork Solomon River		171.6				
Osborne (2)	Kans		26.1	FD	1,800	0.20
Total					6,060	0.53

(1) F - Coagulated, settled, filtered
H - Softened
D - Chlorinated

(2) Five wells also.

Table S-5 lists 31 municipalities that obtain water supplies from ground sources in the Solomon River Basin. These supply a total population of 20,262 with an average of 3.14 million gallons per day. State Geological Survey of Kansas Bulletin 41, entitled "Ground Water Supplies in Kansas Available for National Defense Industries," comments on Solomon River Valley underground water supplies. A map in this bulletin indicates that moderately large supplies of ground water are available along the entire valley of the Solomon River, and upstream on the North and South Forks about 1/4 to 1/3 their lengths. This bulletin also states that in most places the alluvium in the Solomon River Valley contains beds of waterbearing sand and gravel and that individual wells in favorable localities yield 500 to 700 gallons per minute.

Sources of Pollution

Table S-6 summarizes the location and magnitude of significant sources of organic pollution, including data on industrial wastes discharged to streams in the Solomon River Basin. As noted in this table, the population connected to sewers plus a sewered population equivalent of 5,405 from industrial wastes is 22,065. This is

Table S-5 Solomon River Basin

Municipal Water Supplies From Ground Sources

Municipality	State	Source (1)	Treatment (2)	Population Served	Average Consumption M. G. D.
Agra	Kans	SW	N	280	0.03
Alton	Kans	SW	N	270	0.04
Barnard	Kans	SW	N	240	0.01
Bennington	Kans	SW	D	320	0.03
Bogue	Kans	SW	N	210	0.02
Cawker City	Kans	SW	D	640	0.06
Damar	Kans	SW	N	175	0.01
Delphos	Kans	SW	D	720	0.13
Downs	Kans	SW	N	1,250	0.25
Esbon	Kans	SW	N	120	0.01
Gaylord	Kans	SW	D	240	0.05
Glasco	Kans	SW	N	750	0.06
Glen Elder	Kans	SW	N	480	0.03
Hill City	Kans	SW	N	1,150	0.43
Hoxie	Kans	SW	N	1,090	0.45
Kensington	Kans	SW	N	570	0.06
Kirwin	Kans	SW	N	370	0.04
Lebanon	Kans	SW	N	510	0.04
Lenora	Kans	SW	N	480	0.04
Logan	Kans	SW	N	1,050	0.20
Minneapolis	Kans	SW,DW	Dp	2,057	0.20
Palco	Kans	SW	N	280	0.02
Phillipsburg	Kans	SW	ID	2,340	0.32
Portis	Kans	SW	N	240	0.02
Prairie View	Kans	SW	N	170	0.01
Simpson	Kans	SW	N	220	0.02
Smith Center	Kans	SW	ID	1,700	0.25
Speed	Kans	SW	N	70	0.02
Stockton	Kans	SW	N	1,800	0.27
Tipton	Kans	SW	N	190	0.01
Woodston	Kans	SW	N	280	0.01
	Total			20,262	3.14

(1) Source -
SW - Shallow Wells
DW - Deep Wells

(2) Treatment -
N - None
D - Chlorinated
Dp - Partially Chlorinated
I - Iron Removal

Table S-6

Solomon River Basin

Sources of Pollution Including Industrial Wastes Expressed as Sewered Population Equivalent (B.O.D.)

Municipality	State	Miles Above Mouth		Population Connected to Sewers	Treatment (1)	Sewered Population Equivalent (B.O.D.)	
		Solomon River	Tributary			Untreated	Discharged
Minneapolis	Kans	55.8		1,650	N	2,305	2,305
Delphos	Kans	81.6		400	S	400	160
Glasco	Kans	92.9		600	N	750	750
Beloit	Kans	130.6		3,500	N	4,800	4,800
N. Fork Solomon River		171.6					
Downs	Kans		11.5	1,250	ST	1,330	1,130
Gaylord	Kans		42.9	170	S	170	40
Beaver Creek			45.1				
Smith Center	Kans		14.4	1,450	S	1,550	390 (2)
Deer Creek			65.3				
Phillipsburg	Kans		18.0	2,080	S	4,520	3,400 (3)
Logan	Kans		100.0	610	S	610	150
S. Fork Solomon River		171.6					
Osborne	Kans		26.1	1,800	ST	1,800	1,600
Stockton	Kans		76.0	1,400	S	1,400	350
Hill City	Kans		118.0	880	S	1,110	280
Sand Creek			148.0				
Hoxie	Kans		8.0	870	S	1,320	330
	Total			16,660		22,065	16,385

(1) Treatment -
N - None
P - Primary
S - Secondary
ST - Septic Tank

(2) Receiving creek normally dry

(3) Pollution reaches Deer Creek only during high water stages.

reduced by treatment to 16,385, or an average reduction of 26 per cent.

There are 3 municipalities, having a total sewered population equivalent of 7,855, that discharge untreated sewage into the Solomon River. Of the remaining 10 municipalities, 2 with a sewered population equivalent of 3,130 have low efficiency septic tank treatment, and 8 with a sewered population equivalent of 11,080 have secondary treatment. This means that 65 per cent of the sewered population is supplied with sewage treatment facilities which compares favorably with the national average of 60 per cent. In the Solomon River Basin, 18 of the 65 per cent receives septic tank treatment and the remaining 47 per cent receives secondary treatment.

Laboratory Results

Main Stem Solomon River - As indicated on Figure S-1 average summer dissolved oxygen levels above Beloit were satisfactory. Below the points of raw sewage discharge from Beloit and Glasco there is a general downward trend to a 4 ppm oxygen level near Delphos. Following this there is some recovery but the pollution load from the Minneapolis raw sewage again depresses the oxygen concentration to about 4 ppm. B.O.D. levels are fairly high below Beloit, Glasco, and Minneapolis. Median coliform results are uniformly high below Beloit. Excessive chloride concentrations are not a serious problem in this basin although as indicated in Figure 10, some rather high maxima were found in the lower portion of the Solomon River.

Individual laboratory results and corresponding flow data are given in Appendix "H".

South Fork Solomon River - In general average summer season dissolved oxygen values are high and considerably in excess of the B.O.D. Median coliform values are not excessive except below Osborne where the concentration (M.P.N. per 100 ml.) was in excess of 100,000. Chloride is not a serious problem in this basin. Average or median laboratory results are presented in Figures 6, 7, 8 and 9, and S-1. Maximum chloride results are given in Figure 10.

North Fork Solomon River - As in the South Fork, dissolved oxygen levels are high and far in excess of the B.O.D. Median coliform results are of about the same order of magnitude as in the South Fork.

Low-Flow Frequencies

A brief study has been made of the frequency of low monthly flows by months of various points on the main stem during the period of record 1920 to 1945, as taken from the computed and historical records of the U. S. Bureau of Reclamation. A summary of the results is shown in Tables S-7 and S-8.

A similar study was made of the flow in the South Fork, Solomon River at Alton, Kansas. Records at this station were limited so the results, which are also presented in Tables S-7 and S-8, are approximate only.

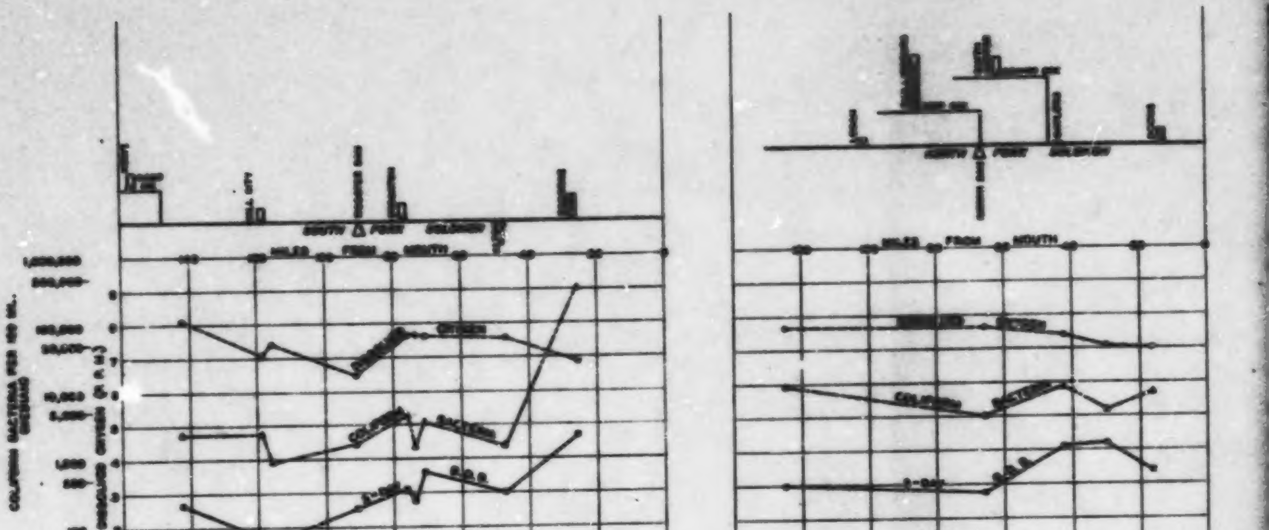
Consideration of low mean monthly flow frequencies is of importance in pollution studies, since an indication is obtained of the frequency with which objectionable conditions have occurred in the past. In computing the low monthly flow frequency, the lowest monthly flow for each year of record is used. Low summer flows include the months from June to September inclusive, and low winter flows include the months of December, and January and February of the following year.

Low summer flows are of interest because of the critical oxygen conditions which may occur during periods of high temperature. Low winter flows are usually only significant either when ice conditions are important or where irrigation is a principal factor. Ice cover can eliminate the reaeration capacity of a stream, thereby creating a need for dilution water at certain low flows. On the other hand, irrigation usage demands maximum storage during winter months, diverting only enough water to bring the low flow up to minimum requirements.

DISCUSSION

As indicated in Table S-6 and Figure S-1, there are 3 municipalities discharging raw sewage to the Solomon River, including the two largest cities, Minneapolis and Beloit, with sewered population equivalents of 2305 and 4800 respectively, and Glasco with a sewered population equivalent of 750. In addition, Downs on the North Fork and Osborne on the South Fork with population equivalents of 1,330 and 1,800 respectively, provide only septic tank treatment which does not reduce appreciably the pollution load from these cities.

The remaining cities have secondary treatment plants which, if of sufficient capacity, and properly maintained and operated, should reduce the pollution load by at least 75 per cent. Phillipsburg, Kansas, located on Deer Creek, a tributary of the North Fork, is an exception as its treatment plant effects a load reduction of approximately 50 per cent. A nearby oil refinery contributes an additional pollutional load as indicated in Table S-6. The combined pollution reaches Deer Creek only during high water stages. This tributary enters the North Fork at River Mile 65.3, over a mile below the Kirwin dam site. Pollution from this city has little,

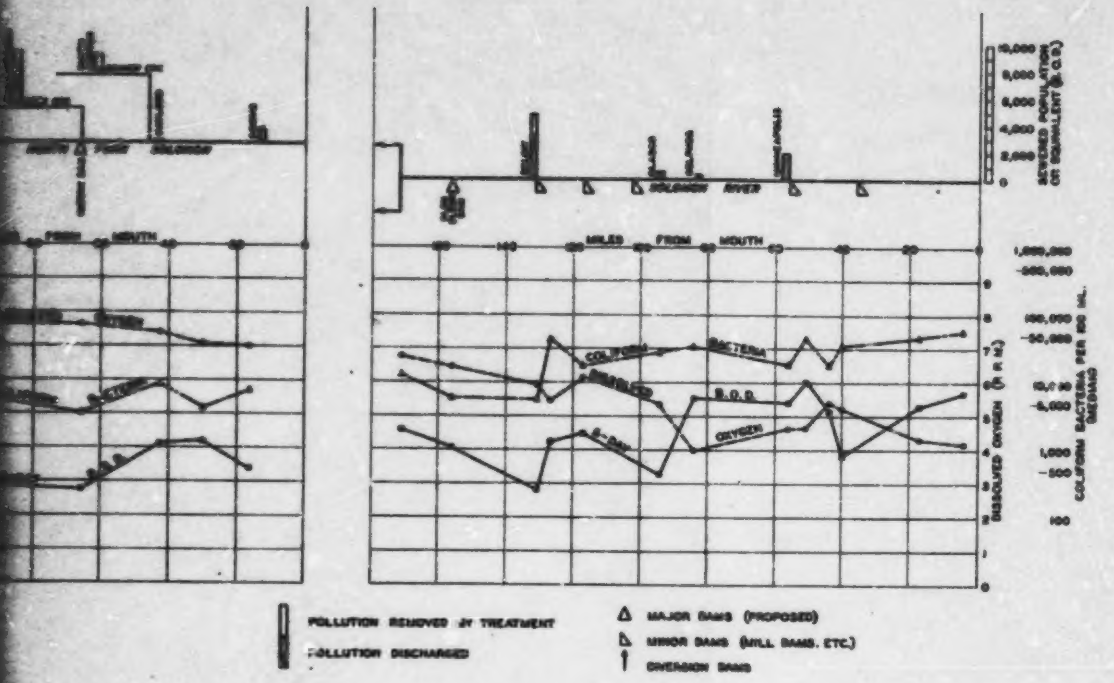


KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE
1949

A

FIG. S-1



SOLOMON RIVER

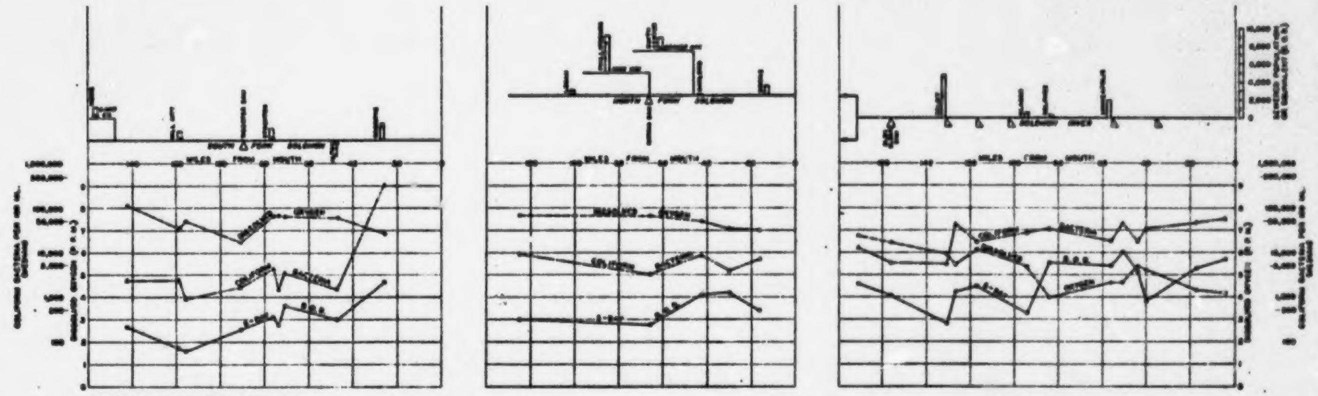
SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON - 1948
(JUNE, JULY, AUG., SEPT.)

B

157-a

FIG. S-1



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE
1948

See the following pages
for greater detail.

SOLOMON RIVER
SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS
SUMMER SEASON - 1948
(JUNE, JULY, AUG., SEPT.)

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Table S-7 Solomon River Basin

Frequency of Low Mean Monthly Summer (June - Sept) Discharges

Years of Record	Stream and Location	Miles to Mouth Solomon River	Miles to Mouth Tributary	Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in: 2 years	3 years	5 years	10 years	Minimum*
	Solomon River								
26	Niles, Kans	16.9		6,767	160	105	65	42	39
26	Minneapolis, Kans	55.8		6,039	120	88	43	27	23
26	Beloit, Kans	130.6		5,430	77	50	30	14	7
26	Glen Elder Dam Site, Kans	156.1		5,076	72	46	26	13	7
8	**South Fork Solomon** Alton, Kans		45.0	1,670	22	18	11	0.77	0.77

Table S-8 Solomon River Basin

Frequency of Low Mean Monthly Winter (Dec - Feb) Discharges

Years of Record	Stream and Location	Miles to Mouth Solomon River	Miles to Mouth Tributary	Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in: 2 years	3 years	5 years	10 years	Minimum*
	Solomon River								
25	Niles, Kans	16.9		6,767	52	42	30	22	18
25	Minneapolis, Kans	55.8		6,039	40	28	22	13	9
25	Beloit, Kans	130.6		5,430	30	19	11	5	2
25	Glen Elder Dam Site, Kans	156.1		5,076	26	15	9	4	2
10	**South Fork Solomon** Alton, Kans		45.0	1,670	21	14	10	4	2.13

* Low Mean Month

other than local, significance except during general high runoff periods and then the dilution factor would be large. On the other hand, if a local freshet on Deer Creek should carry a "slug" of pollution into the North Fork while the latter is at low stage, the downstream consequences might be quite serious especially to aquatic life.

Pollution problems of a local nature will exist at times below the sewered cities in the western portion of this basin despite the high degree of treatment provided by most of them because streams in this area frequently are dry in the summer and fall seasons. These local problems will be most serious below those cities which provide less than secondary treatment.

The most critical problems in the Basin occur on the main stem in the Beloit-Glasco-Minneapolis reach. All of these cities discharge raw sewage to the river. Data shown in Figure S-1 represent the average results on samples collected during the summer season of 1948. Individual samples collected during 1948 showed oxygen values as low as about 2 ppm in the Beloit-Glasco-Minneapolis stream section. Dissolved oxygen data collected during drier summer seasons would have shown more serious oxygen depletions below points of pollution than those indicated. For example, with the pollution load unchanged and a flow equal to the minimum 10 year monthly mean summer flow of 14 c.f.s. (Table S-7), the minimum oxygen values below Beloit would have been about 1.5 ppm and probably only slightly higher below Minneapolis. Dissolved oxygen values below 5 ppm represent unsatisfactory stream conditions. If there is an appreciable decrease in flow below Beloit because of diversion for irrigation use, higher flows will be necessary at Beloit by an amount approximately equal to the net loss of water to irrigation use.

Bacterial pollution of the river by sewage discharge will have more significance if irrigation use is made of the stream water. The importance of this will depend upon the nature of the crops irrigated. Information on this factor is presented in the general discussion in the introductory section of this report. Also, Appendix "F" contains a partial review of the literature on the public health significance of the use of sewage polluted irrigation water.

Beloit, Glasco and Minneapolis need at least primary treatment. With this treatment provided by these cities and assuming no important loss of water between Beloit and the mouth, desirable summer flows at Beloit for the maintenance of 5 ppm of dissolved oxygen in the river would be about 24 c. f. s. Unregulated minimum monthly mean summer discharge at Beloit exceeds this value 80 per cent of the years. On the same basis unregulated winter flows are also adequate.

Stream flow needs for sewage dilution vary with water temperatures. Desirable minimum monthly mean flows (5.0 ppm dissolved oxygen level) in terms of similar summer flows at Beloit are approximately as indicated in Table S-9.

Table S-9 - Solomon River Basin - Seasonal Variations of Desirable Minimum Monthly Mean Flows

Month	Approximate Average Stream Temperature °C	°F	Minimum Monthly Mean Flow as % of Summer Season Flow
January	1	34	20
February	1	34	20
March	3	37	25
April	12	54	40
May	19	66	60
June	22	72	100
July	27	81	100
August	26	79	100
September	24	75	100
October	15	59	45
November	9	48	30
December	2	36	20

Based on the installation of up-to-date primary treatment works at Osborne and Downs, desirable minimum monthly mean summer flows at these cities are estimated to be about 10 c.f.s.

From Table S-7 it will be noted that at Alton, Kansas, on the South Fork, minimum mean monthly summer season flows of reasonable expectancy exceed these values. Winter flows needed are also much less than the unregulated minimum monthly mean winter flows of reasonable expectancy (Table S-8).

Inasmuch as the North Fork and South Fork of the Solomon River are similar regarding drainage area and other general basin characteristics, the flow frequencies on the two streams should closely parallel one another. Comments on irrigation water use and bacterial quality previously given in connection with the main stem apply to the North and South Forks also.

Surface water supplies are usually adequate for those cities making use of them and are rendered potable after treatment by coagulation, filtration, and disinfection. The bacterial loading on the Beloit water plant is fairly high but not excessive for a plant employing excess lime softening, coagulation, filtration and pre-and post chlorination.

Flow regulation by upstream reservoirs should improve the general mineral quality of the surface water supplies at Osborne and Beloit and will, of course, insure adequacy of supply. Mineral quality benefits will also accrue to other downstream surface water supplies; e.g. Topeka and Lawrence. Taste and odor problems at Beloit and Osborne may be rendered more difficult as a result of reservoir construction, however. A general discussion of this problem is presented in the first section of this report.

Water supply problems in the basin are not seriously complicated by high chloride values although occasional high chloride concentrations are found in the main stem, especially in the lower reach where certain of the tributaries are extremely salty. In this connection the comments given in 1911 report of the U. S. Geological Survey, Water Supply Paper 273, page 224, et seq, are of interest and are quoted as follows:

> "It should be noted that two of the affluents (tributaries) of Solomon River - Salt Creek and Plum Creek - carry salt water. Plum Creek, which is the less important of the two, carries the drainage of a small salt marsh into the river at a point below Beloit. Salt Creek is a rather large stream, although in its upper reaches it is often dry. In Lincoln County it receives the drainage of two salt marshes, one of which is on Rattlesnake Creek and the other at the junction of Prosser and Battle Creeks. All of these salt marshes are fed by water which is mineralized by the saliferous shales of the Dakota sandstone...."
>
> "The chlorides in the river at Beloit are in part derived from salt springs on Carr and Hardscrabble creeks and from seepage of the Waconda Springs all of which are in Mitchell County. These salt springs in the saliferous and gypsiferous shales of the Dakota sandstone and other springs having the same origin probably occur in the river valley above Beloit."

Fortunately the Glen Elder, Kirwin and Webster dams are located above the principal sources of natural salt pollution and hence will be able to store water of comparatively low mineral content. Releases from these reservoirs will then serve to reduce chloride concentrations by dilution in the lower stream during normal low flow periods.

SALINE RIVER BASIN

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SALINE RIVER BASIN

SYLLABUS

The Saline River, which lies entirely within the State of Kansas, originates in northwestern Kansas and joins the Smoky Hill River east of Salina. It is reported to be one of the saltiest streams in this country. The dominant occupation in the region is agriculture, although considerable amounts of oil and gas are produced. Public water supplies of all communities in this basin are obtained from ground sources. Organic pollution is light and of only local significance. The high chloride content of the stream is derived principally from natural salt deposits. An active oil well brine disposal program by the State Board of Health has prevented, to a large measure, additional mineralization of streams by these brines. Two dams have been considered. Wilson Dam is now authorized and Russell Dam is under investigation.

CONCLUSIONS

(1) There are no public water supplies obtained from surface sources on the Saline River and its tributaries.

(2) There are 10 cities that obtain public water supplies from ground sources in the Saline River Basin, and furnish an average of 0.78 million gallons per day to a total population of 5,865.

(3) Sewage from a population of 3,030 and industrial waste equivalent to a sewered population of 290, or a total of 3,320, is produced in the Saline River Basin. All sewered communities have secondary sewage treatment plants, which if properly maintained and operated should reduce the sewered population equivalent discharged to the Saline River and its tributaries to 830, or an average reduction of 75 per cent.

(4) Organic pollution of more than local significance does not exist on the Saline River, therefore no diversion for such pollution abatement is necessary below Wilson Reservoir. Minimum monthly average summer flows occurring once in ten years are more than adequate to satisfy organic pollution dilution requirements at Tescott, Kansas. Nuisances and health problems of local significance may occur below Plainville in Paradise Creek, a tributary of Saline River, due to lack of dilution water, especially during the summer months.

(5) The salient water quality feature of many streams in this basin is their high chloride content derived principally from natural salt deposits. Control of oil field brine disposal has prevented further mineralization of the surface water resources of this basin. The chloride problem is discussed in detail in Appendix "D".

(6) Diversion from Wilson Reservoir might be used to supply necessary dilution water to the Smoky Hill and Kansas Rivers, but dilution ratios would need to be maintained so that chlorides in these streams would not exceed desirable limits at points where surface water supplies are located.

RESERVOIR PROJECTS

Table Sa-1 presents information on the authorized Wilson Reservoir on the Saline River, according to information furnished by the Corps of Engineers. The table also mentions Russell Reservoir, which is under investigation, and a supplemental site for Wilson Reservoir on Wolf Creek, that is also being investigated. Wilson Reservoir has a drainage area of 1,935 square miles, or 57 per cent of the total Saline River Basin area.

DESCRIPTION

The Saline River extends about 370 miles from its headwaters in Thomas County in northwestern Kansas to its mouth, where it joins the Smoky Hill River approximately 5 miles east of Salina, Kansas. The Saline River has a drainage basin area of 3,425 square miles. The principal tributaries of the Saline River of interest in this survey are shown in Table Sa-2.

Table Sa-1 Saline River Basin - Reservoir Data (1)

Reservoir	Tributary Stream	Miles to Mouth		Storage, Acre-Feet				Area Max. Pool Acres	Status
		Saline River	Tributary Stream	Silt and Conservation	Irrigation	Flood Control	Total		
Wilson (2)	Saline	130.4		19,000	224,900	145,000	388,900		Authorised
Russell	Saline	169.3		-	-	-	-	-	Under Invest.

(1) Data from Corps of Engineers.

(2) Supplemental site on Wolf Creek being investigated.

Table Sa-2 - Saline River Basin - Principal Tributaries

Tributary	Miles above Saline River Mouth	Drainage Area Square Miles
Mulberry Creek	10.6	430
Spillman Creek	93.7	177
Wolf Creek	121.[illegible]	270
Paradise Creek	160.[illegible]	263
Salt Creek	169.9	-

The upper course of the Saline is dry during most of the year. However, in Sheridan County, Kansas, northeast of Grainfield, the Saline has cut down to the Cretaceous floor of the Tertiary and flows in this formation the remainder of its length as a perennial stream deriving its chief supply from springs in the Tertiary deposits and Dakota sandstone.

The name Saline is well chosen, for it is one of the saltiest streams in the United States. The salt is acquired mainly from salt springs, some of which occur in the bed of the stream as well as in its tributaries. The flow of these springs comes from the saliferous shales of the Dakota formation.

Table Sa-3 lists 11 cities in the Saline River Basin area. Only two of these have U. S. Census (1940) populations over 1,000. They are Lincoln - 1,761, and Plainville - 1,232.

The average annual rainfall of this drainage basin varies from approximately 19" in the extreme western end to about 29" in the eastern end, with an average of 25".

The principal occupation in this area is agriculture, with grain production predominating. There is considerable oil production in this basin, principally in Russell and Ellis counties.

PRESENTATION OF DATA

Public Water Supplies

There are no municipalities in the Saline River Watershed that

Table Sa-3

Saline River Basin

Population of Cities

City	Population - U. S. Census			
	1920	1930	1940	1948*
Beverly, Kansas	264	239	258	216
Brookville, Kansas	212	227	221	216
Hunter, Kansas	226	213	196	206
Lincoln, Kansas	1,453	1,738	1,751	1,898
Lucas, Kansas	623	630	608	600
Luray, Kansas	474	444	395	375
Natoma, Kansas	510	565	661	721
Paradise, Kansas	-	176	161	162
Plainville, Kansas	1,004	1,089	1,222	1,610
Sylvan Grove, Kansas	480	539	540	561
Waldo, Kansas	246	279	237	212

* Estimated - Kansas State Board of Agriculture Bulletin "Population of Kansas" August 24, 1948.

Table Sa-4

Saline River Basin

Municipal Water Supplies From Ground Sources

Municipality	State	Source (1)	Treatment (2)	Population Served	Average Consumption M. G. D.
Brookville	Kans	SW	N	180	0.01
Hunter	Kans	SW	N	120	0.01
Lincoln	Kans	SW	SFD	1,830	0.26
Lucas	Kans	SP,SW	F	670	0.06
Luray	Kans	SW	N	340	0.01
Natoma	Kans	SW	N	670	0.06
Paradise	Kans	SW	N	95	0.01
Plainville	Kans	SW	N	1,310	0.18
Sylvan Grove	Kans	SW	N	480	0.08
Waldo	Kans	SW	N	200	0.08
Total				5,965	0.76

(1) Source -
SW - Shallow Wells
SP - Springs

(2) Treatment -
N - None
D - Chlorinated
F - Coagulated, Settled, Filtered
S - Softened

Table Sa-5

Saline River Basin

Sources of Pollution Including Industrial Wastes Expressed as Sewered Population Equivalent (B.O.D.)

Municipality	State	Miles Above Mouth		Population Connected to Sewers	Treatment (1)	Sewered Population Equivalent (B.O.D.)	
		Saline River	Tributary			Unreduced	Discharged
Lincoln	Kans	87.4		1,500	S	1,500	375
Sylvan Grove	Kans	116.2		400	S	540	140
Paradise Creek		160.4					
Plainville	Kans		45.0	1,130	S	1,280	315
Total				3,030		3,320	830

(1) Treatment -
N - None
P - Primary
S - Secondary

obtain public water supplies from surface sources. Table Sa-4 lists 10 cities with water supplies obtained from ground sources which supply an average of 0.78 million gallons per day to a population of 5,865.

According to Bulletin 41 of the State Geological Survey of Kansas, entitled "Ground Water Supplies in Kansas Available for National Defense Industries," moderately large ground water supplies are available in the Saline River Valley along the lower quarter of its length. Also moderately large ground water supplies are available, approximately, on the upper quarter of the entire Saline River Basin.

Sources of Pollution

Table Sa-5 summarizes the location and magnitude of significant sources of organic pollution, including data on industrial wastes connected to municipal sewers and discharged to streams of the Saline River Basin. As noted in this table, the population connected to sewers, including a sewered population equivalent of 290 from industrial wastes, is 3,320. Proper operation and maintenance of the treatment works provided should reduce the pollution load by at least 75 per cent to a sewered population equivalent of 830. All 3 of the sewered towns, Lincoln, Sylvan Grove and Plainville, have secondary sewage treatment plants and are separated by significant stream mileages. The extent to which the sewered population is supplied with sewage treatment - 100 per cent - is considerably in excess of the national average of about 60 per cent. The most important industrial waste in this basin is the brine produced incidental to the recovery of oil from the various oil and gas fields.

Laboratory Results

Average summer-season dissolved oxygen and B.O.D. data are presented in Figures 6 and 7. Average and maximum chloride results are shown in Figures 9 and 10. Median coliform results are given on Figure 8. Dissolved oxygen values were, in general, in excess of 5.0 ppm. Some of the stations showed average B.O.D. values in excess of 5 ppm and median coliform concentrations (M.P.N. per 100 ml.). of over 10,000. However, Figure Sa-1 which shows sources of pollution as well as average laboratory data indicates that the organic pollution load reaching the river is light. The laboratory data presented in the same figure in general confirm this. Throughout nearly the entire length of the stream, summer average dissolved oxygen values exceed B.O.D. values. There is a significant oxygen sag below Lincoln, Kansas (River Mile Sa-80) but the minimum average dissolved oxygen value at the low point is in excess of 4.0 ppm.

The stream rapidly recovers and about 10 river miles below this point the dissolved oxygen is nearly 6 ppm. The maximum average B.O.D. value of 8 ppm also occurs just below Lincoln. Median coliform values are not excessive; and, inasmuch as no surface water supplies are involved, are not particularly significant if irrigation is not practiced.

Chloride concentrations substantially in excess of 250 ppm are common in the streams in this basin. Other mineral substances occur in rather high concentrations also.

Low-Flow Frequencies

A brief study has been made of the frequency of low monthly flows, by months, for both summer (June-September) and winter (December, and January and February of following year) flows in the Saline River at Tescott, Kansas, 54.5 miles from the mouth. In computing the low monthly flow frequency, the lowest monthly flow for each year of record is used. A summary of the results is shown in Tables Sa-6 and Sa-7.

Consideration of low mean monthly flow frequencies is important in pollution studies because they yield an indication of the frequency with which objectionable flows have occurred in the past. Low summer flows are significant because critical oxygen conditions can occur during periods of high stream temperature. Low winter flows must be considered during conditions where ice cover prevents reaeration of the stream. In this river, low winter flow studies are important because proposed irrigation usage demands minimum release of dilution waters in the winter so that maximum storage can be utilized during the following growing season for irrigation.

DISCUSSION

As shown in Table Sa-5 and Fig. Sa-1, there are 3 municipalities discharging sewage into the Saline River and tributaries. All of these towns have secondary sewage treatment plants that provide an average reduction of about 75 per cent. Slight pollution exists below Lincoln and Fig. Sa-1 indicates a definite B.O.D. increase and oxygen sag below this city. Even though Plainville has a secondary treatment plant, it is probable that local pollution occurs below this town and that at times a health hazard may exist. Stream flow data near this city are not available but it is probable that there is little, if any, dilution water available in Paradise Creek during part of the year. Therefore some of the time the flow in the stream below this town would be entirely sewage treatment plant effluent which, undiluted, is not of satisfactory quality for stream water.

Table Sa-6 Saline River Basin

Frequency of Low Mean Monthly Summer (June - Sept) Discharges

Years of Record	Stream and Location	Miles to Mouth		Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in:				
		Saline River	Tributary		2 years	3 years	5 years	10 years	Minimum*
16	Saline River Tescott, Kans	54.5		2,825	60	32	25	20	19

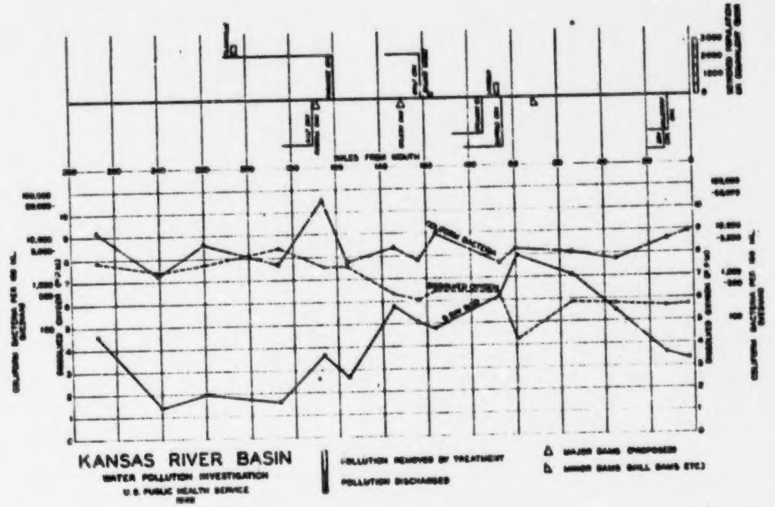
Table Sa-7 Saline River Basin

Frequency of Low Mean Monthly Winter (Dec - Feb) Discharges

Years of Record	Stream and Location	Miles to Mouth		Drainage Area, Square Miles	Minimum Monthly Mean Flows in cubic feet per second that may be expected once in:				
		Saline River	Tributary		2 years	3 years	5 years	10 years	Minimum*
16	Saline River Tescott, Kans	54.5		2,825	27	17	12	10	6

* Low Mean Month

FIG. Sa-1



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE

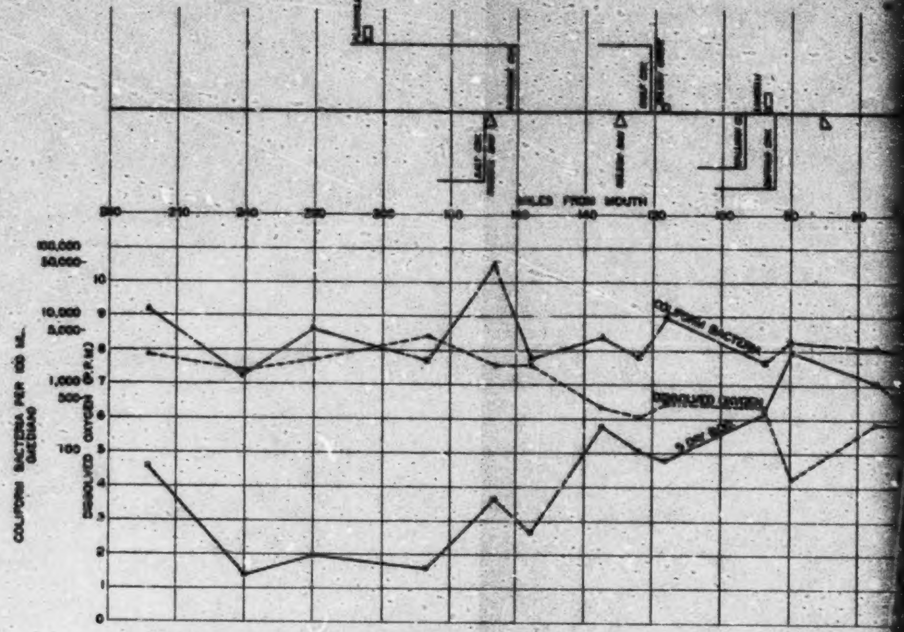
XXXXXXXXXXXXXXXXXXXXXXXX
See the following pages
for greater detail.
XXXXXXXXXXXXXXXXXXXXXXXX

SALINE RIVER

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON - 1949
(JUNE, JULY, AUG., SEPT.)

171-a

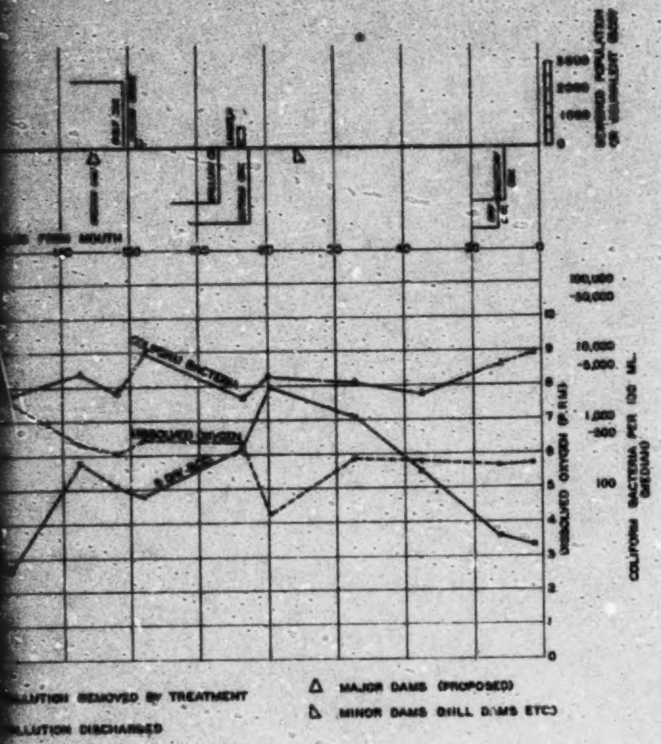


KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION
U.S. PUBLIC HEALTH SERVICE
1949

A

FIG. Sa-I



SALINE RIVER

SOURCES OF POLLUTION
AND
AVERAGE LABORATORY RESULTS

SUMMER SEASON - 1948
(JUNE, JULY, AUG., SEPT.)

B

171-a

Data on organic industrial wastes connected to sewers indicates that such wastes have a population equivalent of 290. As previously mentioned the principal inorganic industrial waste in this basin is oil well brine. This waste is apparently under satisfactory control; the problem is discussed in detail in Appendix "D".

The minimum monthly average summer flow occurring once in 10 years at Tescott, Kansas (River Mile 54.5) is 20 cubic feet per second and the monthly minimum for the period of record is 19 cubic feet per second. While somewhat lower flows would be available at Lincoln, they should be adequate for dilution of the residual sewage load from this city provided, of course, the city's secondary sewage treatment plant is properly maintained and operated.

The outstanding water quality property of the streams in this basin is their high chloride content which apparently is derived principally from natural salt deposits. Comparison of chloride and flow data with similar data obtained prior to the development of oil production indicates that the Saline River water quality has not been adversely affected by oil well brine. This is evidently the result of an active oil well brine disposal program of the Kansas State Board of Health. Without this program there undoubtedly would have been substantial additional mineralization of the streams in this basin. A detailed discussion of the Saline River Basin chloride problem is presented in Appendix "D".

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APPENDIX "A"

MEMORANDUM OF UNDERSTANDING RESPECTING JOINT PROGRAM FOR STREAM POLLUTION INVESTIGATIONS OF THE KANSAS RIVER BASIN

1. THIS MEMORANDUM OF UNDERSTANDING, Made and entered into this seventeenth day of October, 1947, pursuant to the authority contained in the Acts of June 17, 1902 (32 Stat. 388), and acts amendatory thereof or supplementary thereto, known as the Reclamation Laws; the Act of December 22, 1944 (58 Stat. 887), and the Act of July 25, 1947 (Public Law 247, 80th Congress), Flood Control Act approved 28 June 1938 (Public Law 761, 75th Congress) as modified by the Flood Control Act approved 18 August 1941 (Public Law 228, 77th Congress), by and between the BUREAU OF RECLAMATION, and the CORPS OF ENGINEERS, acting as agencies on behalf of THE UNITED STATES OF AMERICA, and the KANSAS STATE BOARD OF HEALTH, represented by the contracting officer executing this agreement, and the NEBRASKA STATE DEPARTMENT OF HEALTH, also represented by the contracting officer executing this agreement on its behalf; all as parties of the first part; and the UNITED STATES PUBLIC HEALTH SERVICE, as party of the second part,

WITNESSETH, THAT:

2. WHEREAS, the Bureau of Reclamation and the Corps of Engineers, on behalf of the United States of America are now engaged in the construction of the Missouri Basin Project, and it has been determined by such agencies and the health departments of the States of Kansas and Nebraska that it is necessary to conduct a study of stream pollution in the Kansas River Basin in order to secure data for use in planning maximum water utilization in such basin as a part of the general plans for the Missouri River Basin Project, and that such study should include, among other things: (a) The extent, types, and major sources of pollution; (b) A review of existing State laws in Nebraska, Kansas, and Colorado, and pending legislation regarding pollution of public waters; (c) Minimum stream flows necessary below the reservoirs for public water supplies and for sanitation purposes with present and contemplated pollution; (d) Public water supply needs; (e) Possible benefits to abatement of water pollution problems by reservoir releases and the return of irrigation water; and (f) Recommendations and existing plans for pollution abatement; and

3. WHEREAS, the Bureau of Reclamation, the Corps of Engineers, and the States of Nebraska and Kansas do not have the necessary

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trained and experienced personnel required to perform the pollution survey and study contemplated herein, and do not have all of the necessary equipment required for such a study, and it is necessary therefore to request the Public Health Service to conduct the stream pollution survey of the Kansas River and its tributaries, and the said Public Health Service is willing to conduct such survey on the terms and conditions hereinafter set forth,

NOW, THEREFORE, it is mutually understood and agreed by and between the parties hereto as follows:

4. Beginning on or about November 1, 1947, and continuing for a period of approximately one year thereafter:

(a) The Public Health Service will conduct a stream pollution survey of the Kansas River and its tributaries, which survey will include, among others, the items set forth in Article 2 hereof. The personnel involved in making such a survey shall be under the supervision of the Public Health Service during their work on the pollution survey. The Public Health Service shall assume full responsibility for the survey and the preparation of complete reports thereon. An interim report will be prepared and submitted to the participating agencies by January 1, 1948, and a final report, which will include the findings, conclusions, and recommendations will be submitted on or before June 30, 1949. The number of copies of the reports furnished to the participating agencies shall be as follows: 20 copies each to the Bureau of Reclamation, the Corps of Engineers, and the State of Kansas, and 10 copies to the State of Nebraska. In addition, the Public Health Service will consult with the health officials of the State of Colorado relative to its pollution problems as involved in the Kansas River Basin, and copies of the reports made by the Public Health Service will be furnished to the State of Colorado.

(b) In connection with the survey contemplated herein, the Public Health Service will furnish, as required, the following services and facilities:

One (1) mobile laboratory unit and field office.
Two (2) sanitary engineers (part time)
One (1) bacteriologist (part time)
One (1) chemist (part time)
One (1) biologist (part time)

(c) The Corps of Engineers, as its part of this cooperative agreement, will share in the actual costs incurred by the Public Health Service in making such stream pollution survey to the extent of not more than $10,500.00, such costs to be computed on a monthly basis, and duly transferred by the Corps of Engineers to the Public Health Service on the usual 1080 voucher form after proper statements have been rendered by the Public Health Service to the Corps of Engineers showing the actual costs incurred. In addition to sharing in the costs aforesaid, the Corps of Engineers will provide the following for the use of the Public Health Service in connection with such pollution survey:

One (1) clerk-stenographer for pollution survey office
One (1) engineer, part time, for hydrometric data
Two (2) sample collectors
Two (2) automotive vehicles and operational expenses, which shall include gas, oil, tires, repairs, and other necessary maintenance, but not a driver
Such drafting assistance, maps, charts, available data as may be required

(d) The Bureau of Reclamation, as its part of this cooperative agreement, will share in the actual costs incurred by the Public Health Service in making such stream pollution survey to the extent of not more than $12,800.00, such costs to be computed on a monthly basis and duly transferred by the Bureau of Reclamation to the Public Health Service on the usual 1080 voucher form after proper statements have been rendered by the Public Health Service to the Bureau of Reclamation showing the actual costs incurred. In addition to sharing in the costs aforesaid, the Bureau of Reclamation will provide the following for the use of the Public Health Service in connection with such pollution survey:

One (1) laboratory aide
One (1) sample collector
One (1) automotive vehicle, and operational expenses, which shall include gas, oil, tires, repairs, and other necessary maintenance, but not a driver
One (1) engineer, part time, for hydrometric data
Such maps, charts, available data as may be required

(e) The Kansas State Board of Health, as its part of this cooperative agreement, will not share in the actual costs incurred by the Public Health Service in making such stream pollution survey, but will provide the following for the use of the Public Health Service:

Laboratory services at Lawrence, Kansas, to the extent of 20 samples per week
One (1) sanitary engineer, half-time and travel
One (1) engineer, one-third time and travel
One (1) Chemist-bacteriologist

The estimated value of such above mentioned services is $12,900.00.

(f) The Nebraska State Department of Health, as its part of this cooperative agreement, will not share in the actual costs incurred by the Public Health Service in making such stream pollution survey, but will provide the following for the use of the Public Health Service:

One (1) sanitary engineer, one-quarter of his time, and travel
One (1) sample collector and automobile, plus operational expenses, which shall include gas, oil, tires, repairs, and other necessary maintenance

The estimated value of such above mentioned services is $6,500.00.

5. Where the operations of this contract extend beyond the current fiscal year, the contract is made contingent on the Congress making the necessary appropriations for expenditures hereunder after such current year shall have expired. In case such appropriation as may be necessary to carry out this contract is not made, the State agencies who are parties hereto hereby release the United States from all liability due to the failure of the Congress to make such appropriation.

6. No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise herefrom, but this restriction shall not be construed to extend to this contract if made with a corporation or company for its general benefit.

IN WITNESS WHEREOF, The parties hereto have caused this memorandum of agreement to be executed as of the day and date first above written.

BUREAU OF RECLAMATION

By /s/ Avery A. Batson
Regional Director,
Region 7
Denver 2, Colorado

CORPS OF ENGINEERS

By /s/ Lewis A. Pick
Brigadier General, CE
Division Engineer
Missouri River Division

PUBLIC HEALTH SERVICE

By /s/ J. O. Dean
Director, District No. 7

KANSAS STATE BOARD OF HEALTH

By /s/ F. C. Beelman, M.D.
Secretary and Executive Officer,
Topeka, Kansas

NEBRASKA STATE DEPARTMENT OF HEALTH

By /s/ W. S. Petty, M.D.
Director of Health
Lincoln, Nebraska

APPENDIX "B"

STATE WATER POLLUTION CONTROL LEGISLATION

(Outline prepared by Office of the General Counsel, Federal Security Agency, in consultation with the Division of Water Pollution Control of the Public Health Service - February - 1949.)

PRELIMINARY STATEMENT

The greatest State legislative activity in the field of water pollution in the history of this country has occurred in the past decade. About half of the States have passed new laws or amended their old statutes within this period. Since this type of legislation has been concentrated within a relatively recent period, it is not surprising to find a marked similarity in the enactments. In general, they have followed the technique of setting up an administrative agency to deal with the problem of water pollution control. Legally, the problem is largely a specialized application of the principles of administrative law.

It is characteristic of State water pollution control legislation to set up a body of statutory and administrative law superimposed on the common law remedies of private parties. The older State legislation was marked by a piecemeal lodging of concurrent water control statutory authority within several departments of the State, such as those dealing with health, agriculture, fish and wild life, and mines and minerals. The modern tendency is to coordinate all State water pollution control activity under a single administrative agency.

As in most cases where the administrative law approach has been applied, the efficacy of a particular program depends on many extra-legal elements such as administrative personnel, size of appropriation, and public understanding.

The following is an outline of component parts, with suggested criteria, for a State statute for the purpose of establishing and carrying out a program for water pollution prevention and control. This outline will be further developed from time to time on the basis of continued study, consultations and experience.

STATEMENT OF POLICY

A declaration of State policy in the statute is desirable. Such a declaration indicates the basic objectives which are to guide the State agency in the exercise of authority delegated to it by the legislature and is an aid to the administrative agency and the courts in the interpretation of the statute. Such a statement might read:

> "Whereas the increase in pollution of the waters of this State, due to the growth of population and industrial activities, constitutes a menace to health and welfare, threatens the extinction of fish and aquatic life, and progressively obstructs agricultural, industrial, recreational, and other legitimate uses of water, and whereas the problem of water pollution in this State is closely related to the problem of water pollution in adjoining States, it is hereby declared to be the public policy of this State to conserve the waters of the State for public water supplies, for the propagation of fish and aquatic life, and for agricultural, industrial, recreational and other legitimate uses, to provide a comprehensive program in the public interest for the prevention, abatement, and control of pollution, to provide effective means for the carrying out and enforcement of such program, and to provide for cooperation with agencies of other States and of the Federal Government in carrying out these objectives."

ADMINISTRATIVE AGENCY

1. Administrative authority and responsibility should be vested in a single State agency with comprehensive powers. There should be no exemption of particular municipalities, areas or industries from the jurisdiction of the agency.

   Such a single State agency, charged with comprehensive power and responsibility for carrying out State laws relating to water pollution abatement, would constitute the "State water pollution agency" for purposes of recognition as such under the Federal Water Pollution Control Act. See Sec. 10 (a).

2. The State agency might be:

   (1) a single administrator,

   (2) a commission, with members appointed by the Governor, or

   (3) an ex-officio board, composed of heads of State

departments having related responsibilities, such as health, conservation, agriculture, etc., or

(4) variations of the above.

3. Establishment of the agency in the State health department is recommended. If the agency is of the board or commission type the State health officer should be a member.

4. If the agency is to be an ex-officio board, it may be desirable to fix by statute a minimum number of meetings per year.

5. Provision should be made for an executive officer, and there should be authority for the appointment of personnel, including consultants and hearing officers. The merit system should be applicable to personnel of the agency.

6. The agency should be authorized to utilize the personnel and facilities of other State agencies and to make reimbursement therefor.

7. It may be desirable to authorize delegations of authority to subordinate officials, excepting, however, in such matters as the adoption of rules and regulations, comprehensive programs and standards of water purity, the classification of waters, and the issuance of orders or making of any final determination which directly affects the activities or interests of any person or group.

ADVISORY FUNCTIONS

If the agency is of a single-administrator type, a supplementary council with purely advisory functions may be a useful adjunct; such a council may be composed of representatives of other State departments having related responsibilities or (like the Water Pollution Control Advisory Board in the Public Health Service) be expanded to include a limited number of persons (appointed for limited terms) representative of particular fields of expert knowledge, public and private interests. For other types, the value of a statutory advisory council is likely to be less, but the agency should in any case have authority to advise and consult with interested and affected groups. (See "Powers and Duties")

POWERS AND DUTIES

The water pollution agency should have the following powers and duties:

1. To develop a comprehensive program for the prevention, control and abatement of water pollution throughout the entire State;

2. To advise, consult, and cooperate with other agencies of the State, other States and the Federal Government and with affected groups and industries, in the formulation and carrying out of such a program; to accept and administer loans and grants from the Federal Government and from other sources for carrying out any of its functions;

3. To encourage and conduct studies, investigations, research and demonstrations (with specific mention of industrial waste problems); to collect and disseminate information relating to water pollution and the prevention, control and abatement thereof;

4. To set standards of water purity and classify waters according to their particular uses;

5. To adopt, after hearing, general rules and regulations pertaining to the prevention, abatement and control of water pollution. For example, such rules and regulations might require, among other things, that permits for the operation of treatment works be obtained in certain cases in which they would not otherwise be mandatory under the statute. (See below under "Enforcement" for those cases in which permits should be required by the statute.) They might also establish standards for the operation of disposal systems and treatment works.

6. To issue, after hearing, orders abating discharges or requiring the adoption of such remedial measures, including the construction of new disposal systems or treatment works or the modification, extension or alteration of existing systems and works, as the agency deems necessary or proper; to receive complaints and make investigations in connection with the foregoing;

7. To examine and pass upon all plans and specifications for, and to inspect the construction of (a) new disposal systems and treatment works, (b) extensions, modifications or additions to new or existing disposal systems or treatment works, and (c) extensions and modifications or additions to factories, manufacturing establishments or business enterprises, the operation of which would cause a substantial increase in the pollutional load. (See below under "Enforcement" for suggestion that approval of plans and specifications be required

for construction of certain disposal systems and treatment works);

8. To issue, continue in effect, revoke, modify or deny permits, under such conditions as it may prescribe, for the discharge of any wastes, and for the installation and operation of disposal systems and treatment works. (See below under "Enforcement" for suggestion that permits be required for waste discharges);

9. To take all action necessary or appropriate to secure to the State the benefits of the Federal Water Pollution Control Act (Public Law 845, 80th Congress; 62 Stat. 1155). (See the draft Water Pollution Control Enabling Act for specific functions which would be involved in so doing; it is not suggested that these be spelled out in a comprehensive water pollution control statute except to the extent that legal authorities of the State may consider specification necessary. This draft act was proposed by the Council of State Governments as part of its 1949 legislative program. Copies of the draft act were submitted by the Council directly to the States.)

ENFORCEMENT

It is suggested that the water pollution control law contain enforcement provisions along the following lines:

1. Sanctions against pollution

   (a) Prohibit discharge of any wastes from any disposal system or treatment works constructed or operated (i) without a permit from the agency in cases where a permit is required by the statute (see below) or by the rules, regulations or orders of the agency, or (ii) in contravention of the terms of a permit or of the rules, regulations or orders of the agency;

   (b) (i) As to new disposal systems and treatment works, plans and specifications should be required to be submitted and approved and permits issued by the agency as prerequisites to their initial construction and operation, as well as to the construction and operation of any extensions, modifications or additions thereto;

   (ii) As to existing disposal systems and treatment works, plans and specifications should be required to be submitted and approved and permits issued by the agency as prerequisites to the construction and operation of any extensions, modifications and additions thereto. (See paragraph 5 of "Powers and Duties" above for authority of agency to require, by rule or regulation, that permits be obtained for the continued operation of existing systems or works);

(iii) The submittal of plans and specifications and the issuance of permits should be required for the construction of extensions, modifications, or additions to manufacturing establishments or business enterprises, the operation of which would cause a substantial increase in waste discharges.

(c) Prohibit performance of any act which causes or which may tend to cause pollution in contravention of the standards of water purity adopted by the agency or which is in violation of the rules, regulations or orders of the agency.

(d) Violation of prohibitions in (a), (b), and (c) above punishable by fine, or by fine and/or imprisonment. Statute might also provide for criminal liability of officers and directors of corporation for violations by the corporation.

(e) Each day on which a violation occurs deemed a separate and additional violation.

2. Investigations

The agency should have the power to enter at reasonable times upon any private or public property for the purpose of inspecting and investigating conditions which contribute, or threaten to contribute, to the pollution of any waters.

3. Hearings

(a) The agency should be required to grant a hearing before any rules or regulations of general applicability are adopted which pertain to the prevention, abatement or control of water pollution (e.g., regulations setting standards for the operation of disposal systems and treatment works), or before any order is issued by the agency (e.g., order prohibiting respondent from discharging wastes), or before any other final determination is made (e.g., revocation, modification, etc., of a permit) which directly affects the activities or interests of any person or group. Provision may be made for summary procedures in emergencies involving hazards of an imminent nature.

(b) The agency should have necessary incidental powers such as the power to compel the attendance of witnesses and the production of testimony, to administer oaths, and examine witnesses.

(c) Safeguards should be provided such as the requirements of (i) seasonal notice, including publication thereof in the event that the proposed proceedings affect a group or groups of individuals, (ii) opportunity of respondents to file answers, and (iii) oppertunity of respondents to be represented by counsel at the hearing, (Such safeguards may be spelled out in the statute or provided for by regulations.)

4. Legal action

(a) The agency should be empowered to bring action to enjoin violation of law or of its rules, regulations or orders.

(b) The Attorney General of the State may be required to bring civil or criminal action on the request of the agency to enjoin or punish violations.

5. Judicial review

Judicial review of all final orders of the agency should be provided.

DEFINITIONS

A definition section is an integral part of a comprehensive water pollution control statute. As the purpose of a definition section is to implement the administration and interpretation of the statute, care should be taken to avoid either unduly restrictive or vague definitions.

Terms for which definitions are usually desirable are "sewage", "industrial wastes", "other wastes", "pollution", "sewerage system", "treatment works", "disposal system", "waters of the State", and "persons". While there do not seem to be significant differences among the several States in definitions of the same or similar terms, several caveats are offered:

1. Rigid State-wide definitions of "tolerable pollution" appear to be unsatisfactory as they are either too vague to permit accurate judicial interpretation or too rigid to permit reasonable enforcement. Administrative authority should be delegated to determine the degree of permissible pollution in any given body of water.
2. In the definition of "pollution", the jurisdiction of the State water pollution control agency should be made to extend to those discharges into waters of the State which may create a nuisance or be actually or potentially harmful and detrimental to public health, fish and aquatic life, or recreational, agricultural, industrial or other legitimate uses of water.
3. The definition of the term "person" should not be restrictive but should include the State, any municipality, county, sanitary district, public or private corporation, co-partnership, firm or other entity or individual.

PRESERVATION OF EXISTING RIGHTS AND REMEDIES

A provision should be included to preserve existing legal remedies and safeguards against injuries, actual or threatened, due to water pollution. Such a provision could read:

> "It is the purpose of this Act to provide additional and cumulative remedies to prevent, abate and control the pollution of the waters of the State. Nothing herein contained shall be construed to abridge or alter rights of action of remedies in equity or under the common law or statutory law, criminal or civil, nor shall any provision of this Act, or any act done by virtue thereof, be construed as estopping the State, or any municipality or person, as riparian owners or otherwise, in the exercise of their rights in equity or under the common law or statutory law to suppress nuisances or to abate pollution."

SERVERABILITY

A serverability clause should be included to provide that if any part of the statute is declared unconstitutional, the other parts shall not thereby be effected.

CONSTRUCTION AND FINANCING OF SEWERAGE CONSTRUCTION

It is reported that additional legislation is needed in many States to enable municipalities to take full advantage of the loan provisions of the Federal Water Pollution Control Act. The Federal Works Agency has drafted legislation suitable for each of the States where such legislation is desirable to facilitate municipal action for this purpose. Division counsel of the Bureau of Community Facilities of the Federal Works Agency, located in nine field offices of that Agency, are available to discuss such drafts with interested State officials.

APPENDIX "C"

CHLORIDE STUDIES - SMOKY HILL RIVER

INTRODUCTION

Incidental to the production of oil, there is lifted to the surface quantities of brine or salt water varying from insignificant amounts to over 95% of the well production. These brines often contain considerable quantities of sodium, calcium and magnesium chlorides with concentrations reported as high as 125,000 ppm chloride ion (2). Early brine disposal methods usually consisted of the uncontrolled discharge of the liquid. Later, the brine or salt water pond was developed to prevent the mineralized waters from reaching water courses. This method, however, permitted the pollution to continue by leaks through the embankment, downward infiltration to the water table and accidental or inadvertant spills. The most satisfactory means developed for the control of salt water is the subsurface brine disposal method. It consists of returning the brine to underground formations capable of handling the volumes produced.

Since high chloride concentration is a characteristic of many oil well waters, determinations of this substance in a stream and proper interpretation of the results will give a reliable indication of the degree of oil brine pollution . Inasmuch as the Smoky Hill River drains important oil producing areas in West-Central Kansas a special study of the effect of oil field brine wastes on the quality of surface water in this basin was conducted.

METHOD

In order to determine the possible contribution of chloride by the oil fields, sufficient data (flow and chloride concentration) were collected to determine the present condition of the river. These data were then compared with results of chloride determinations made before development of the oil fields.

To provide base data every sample taken in this basin during the course of the comprehensive survey was analyzed for chloride, and a special study of the chloride content of the Smoky Hill River and its tributaries was carried out from December 1-4, 1948. In the course of this special study the river was sampled from below the confluence of the Smoky Hill and Saline Rivers to Russell Springs, Kansas, where the Smoky Hill is ordinarily only a small creek. A number of tributaries not included in the routine program

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were also sampled during this study. In addition, chloride results of the U. S. Geological Survey at various points in 1892-93, 1906, 1907, and 1908 (1) were compiled.

RESULTS

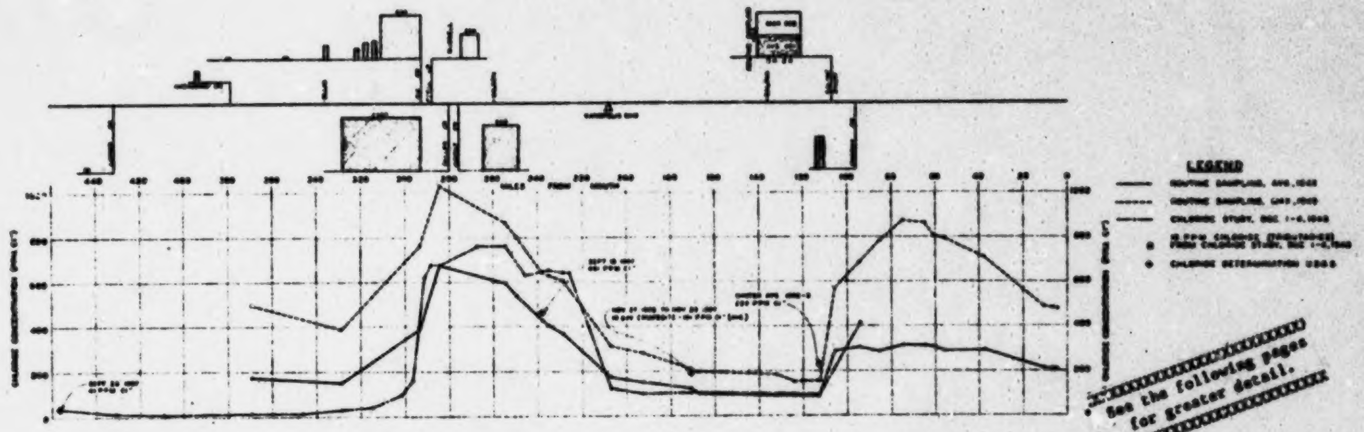
The chloride results on the Smoky Hill are tabulated in Tables I through IV and plotted on Figure I of this Appendix. The results shown include those of the special study in December, 1948, the average and maximum chloride results from the routine sampling in 1948 and results from U. S. Geological Survey Water Supply Paper 273 (1892 - 1908). The curves shown indicate a similar trend, and thus need not be discussed separately.

As illustrated in Figure I, the chloride concentration at River Mile SH-456.1, the uppermost point sampled in the special study, was 41 ppm. The chloride concentration decreased to less than 20 ppm in the next 20 river miles, and remained at this concentration as far downstream as Ellis, Kansas (River Mile SH-346.3). Below Ellis the salt concentration gradually increased to a concentration of 160 ppm about 5 miles west of Russell, Kansas (River Mile SH-296.5). In the next five miles the concentration rose sharply to an average of over 600 ppm, reaching its peak at about River Mile SH-270. The chloride concentration remained high as far east as Kanopolis Reservoir (River Mile SH-207.8), although gradually decreasing in this reach. Below Kanopolis Reservoir the concentration was greatly reduced, from maximum values of over 600 ppm above the reservoir, to maximum values of about 300 ppm below. The concentration continued to decrease until the entry of the Saline River at SH-106.5, with an average chloride concentration of less than 100 ppm above the mouth of the Saline, and an average of almost 300 ppm below. The decrease in chloride concentration below the Saline River mouth was slow, and where the Smoky Hill and the Republican River join the average concentration was still 200 ppm.

DISCUSSION

The fact that the chloride concentration of the river decreases with an increase in flow is well known. The approximate relationship between chloride concentration and flow was determined from data collected during the course of this study. Flow data at the time of sampling were furnished by the U. S. Geological Survey. The five sampling points for which these data are plotted, Figure II, this Appendix, lie between the principal area of chloride pollution and Kanopolis Dam. The curve indicates a hyperbolic relationship between chloride concentration (ppm Cl^-) and stream flow (c.f.s.); the equation being: Cl^- (ppm) x Flow (c.f.s.) = 21,100. This curve was fitted by the method of averages and, as

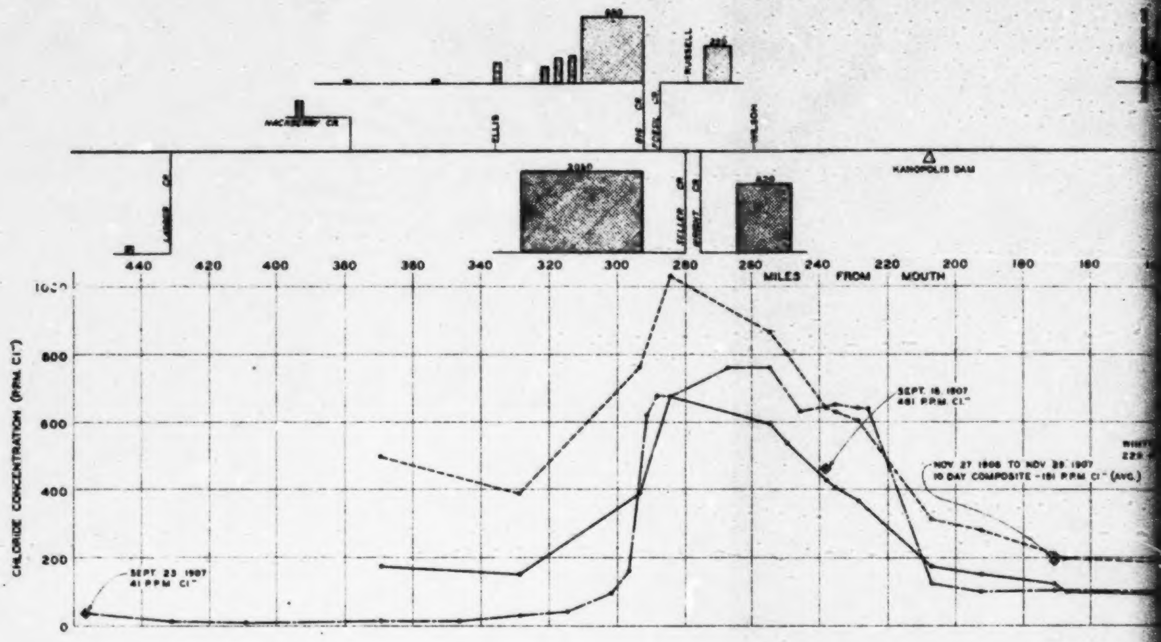
FIG. I (APP. C)



See the following pages
for greater detail.

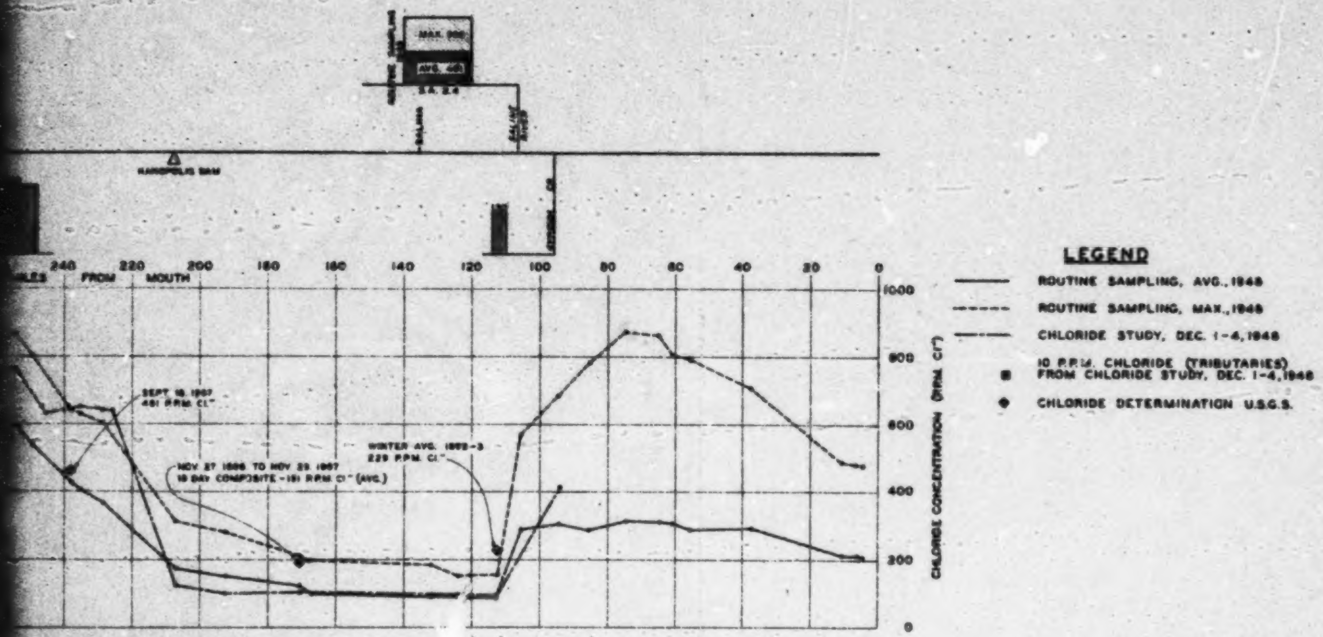
KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
SMOKY HILL RIVER BASIN
CHLORIDE DETERMINATIONS
U. S. PUBLIC HEALTH SERVICE
1949

191-a


880
225
RUSSELL
HACKBERRY CR
ELLIS
BIG CR
FOSSIL CR
WILSON
KANOPOLIS DAM
LADDER CR
2050
620
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
MILES FROM MOUTH
CHLORIDE CONCENTRATION (P.P.M. Cl⁻)
1000
800
600
400
200
0
SEPT. 23 1907
41 P.P.M. Cl⁻
SEPT. 16 1907
461 P.P.M. Cl⁻
NOV 27 1906 TO NOV 29 1907
10 DAY COMPOSITE - 181 P.P.M. Cl⁻ (AVG.)

A

FIG. I (APP. C)



KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION

SMOKY HILL RIVER BASIN

CHLORIDE DETERMINATIONS

U. S. PUBLIC HEALTH SERVICE
1949

B.

FIG. II CHLORIDE STUDIES—SMOKY HILL RIVER

RELATIONSHIP OF CHLORIDE CONCENTRATION (PPM) AND STREAM DISCHARGES (C.F.S.)

AT: SH-228.5, SH-235.2, SH-238.0, SH-249.8, AND SH-254.6

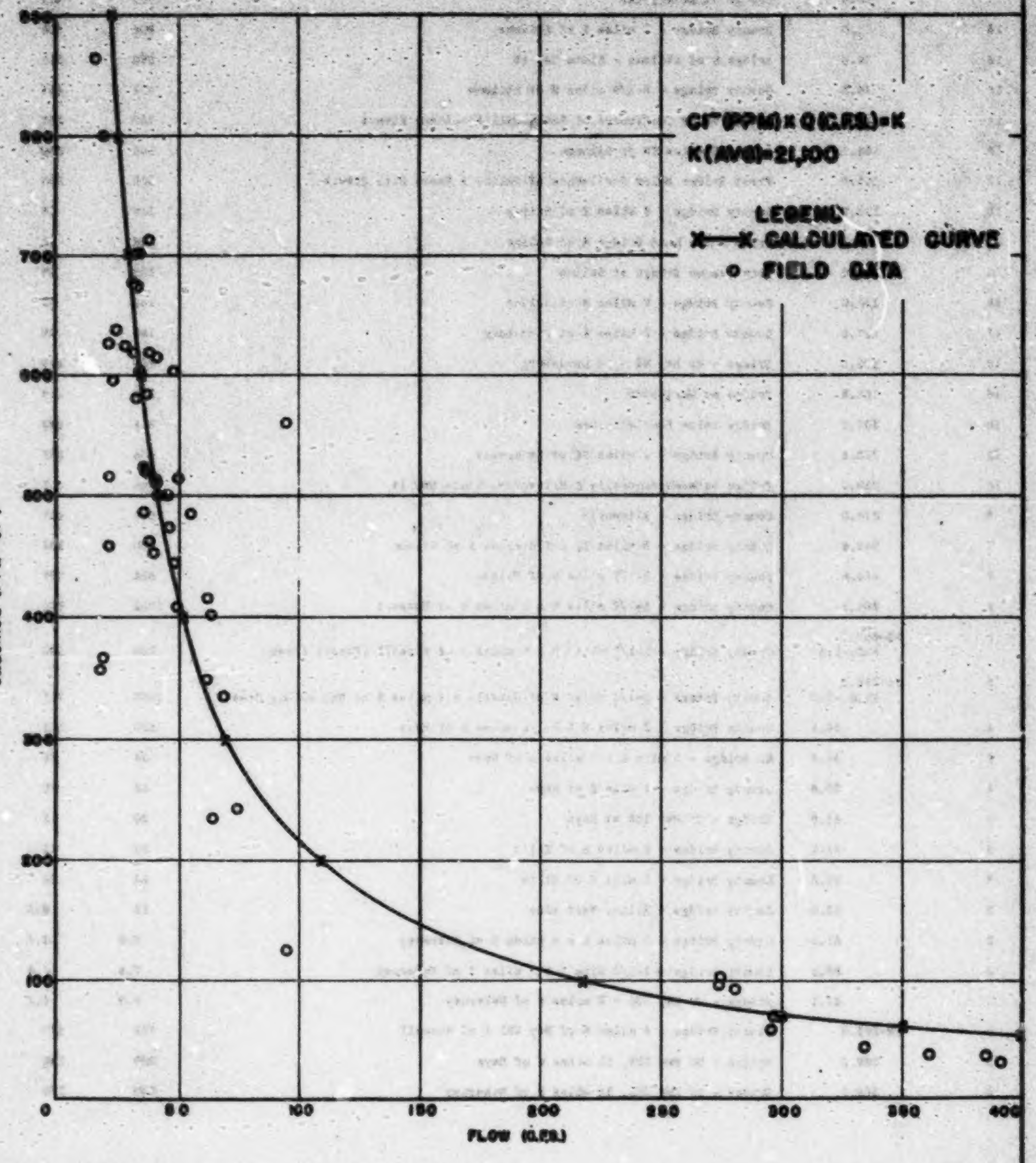


TABLE I

CHLORIDE STUDIES - SMOKY HILL RIVER

Chloride Results of Routine Sampling During 1960

Summary of Results

No. of Samples	Sampling Points River Mile	Description	Chloride (Cl⁻) - ppm Max.	Avg.	Min.
13	SH- 4.6	No Bridge - 1 mile E of Junction City	470	270	38
12	6.4	Bridge - East of Junction City	480	200	34
13	10.9	Bridge - US Hwy 77 S of Junction City	460	218	22
7	SH- 14.0 Ly.C.-1.8	Bridge - US Hwy 77 - 3 miles S of Junction City (Lyons Creek)	77	47	29
20	SH- 37.8	Bridge at Chapman	708	238	10
17	55.4	Bridge at Enterprise	790	287	15
18	61.0	County Bridge - 2 miles E of Abilene	804	308	17
18	64.8	Bridge S of Abilene - State Hwy 15	860	312	19
16	74.8	County Bridge - 2-1/4 miles W of Abilene	972	314	34
18	88.3	Bridge below Confluence of Smoky Hill & Solomon Rivers	790	287	28
18	94.1	Bridge 6 miles SW of Solomon	588	204	30
18	105.8	First Bridge below Confluence of Saline & Smoky Hill Rivers	568	286	34
15	112.7	County Bridge - 3 miles E of Salina	156	86	28
20	120.4	North State Road Bridge E of Salina	158	82	25
20	124.0	Iron Avenue Bridge at Salina	152	88	21
19	132.0	County Bridge - 3 miles S of Salina	182	89	21
11	167.4	County Bridge - 2 miles E of Lindsborg	186	99	18
16	170.9	Bridge - US Hwy 81 - at Lindsborg	207	119	9
16	192.5	Bridge at Marquette	270	149	77
18	207.2	Bridge below Kanopolis Dam	314	172	70
13	220.8	County Bridge - 2 miles SE of Kanopolis	604	365	30
18	228.2	Bridge between Kanopolis & Ellsworth, State Hwy 14	628	406	35
8	238.0	County Bridge - Ellsworth	640	427	50
7	249.8	County Bridge - 3 miles E, 2-1/4 miles S of Wilson	800	558	89
7	254.6	County Bridge - 2-1/2 miles S of Wilson	884	507	88
6	284.1	County Bridge - 3-1/2 miles E & 6 miles S of Russell	1032	674	208
5	SH-287.7 F.C.-1.4	County Bridge - 1-1/2 miles E & 5 miles S of Russell (Fossil Creek)	290	196	75
5	SH-292.1 Bi.C.-2.2	County Bridge - 3-1/2 miles W of Russell & 6 miles S of Hwy 40(Big Creek)	1460	711	135
4	34.4	County Bridge - 2 miles E & 2-1/2 miles S of Hays	820	281	58
2	36.8	No Bridge - 1 mile E & 2 miles S or Hays	34	23	12
4	39.8	County Bridge - 1 mile S of Hays	45	25	6.7
4	42.6	Bridge - US Hwy 183 at Hays	20	12	1.6
3	57.1	County Bridge - 3 miles E of Ellis	37	21	9.0
3	59.6	County Bridge - 1 mile E of Ellis	54	28	8.0
3	63.0	County Bridge - Ellis, West side	12	9.5	8.0
2	81.0	County Bridge - 3 miles E & 4 miles S of WaKeeney	7.0	6.2	5.5
2	83.5	County Bridge - 1-1/2 mile E & 3 miles S of WaKeeney	7.4	6.4	5.5
2	87.1	Bridge - US Hwy 283 - 2 miles S of WaKeeney	6.9	6.2	5.4
5	SH-298.5	County Bridge - 4 miles W of Hwy 281 S of Russell	762	390	118
3	308.6	Bridge - US Hwy 183, 11 miles S of Hays	380	158	31
3	368.6	Bridge - US Hwy 283, 16 miles S of WaKeeney	800	170	15

TABLE II

CHLORIDE STUDIES - SMOKY HILL RIVER

December 1 - 4, 1948

Summary of Results

Sampling Points				Chloride (Cl⁻) - PPM	
	River Mile				
No.	Main Stem	Tributaries	Description	Main Stem	Tributaries
1	SH- 84.1		Bridge 2 miles SW of Solomon	410	
2	90.2	Gyp.C.-2.8	Bridge 6 miles SW of Solomon		180
3	112.7		County Bridge 2 miles East of Salina	86	
4	124.0		Iron Avenue Bridge at Salina	80	
5	170.9		U.S. Hwy 81 at Lindsborg	100	
6	192.8		Bridge at Marquette	90	
7	207.2		Bridge below Kanopolis Dam	120	
8	222.7		County Bridge SE of Kanopolis	660	
9	228.6		County Bridge 2 miles SE of Kanopolis	640	
10	236.2		State Hwy 14 - between Kanopolis and Ellsworth	650	
11	239.0		Bridge at Ellsworth	640	
12	245.6		Bridge at Black Wolf	650	
13	254.6		County Bridge 3-1/2 miles S of Wilson	760	
14	267.5		County Bridge 3-1/2 miles S of Dorrance	760	
15	275.3	Wr.C.-0.1	Wright Creek - 5-1/2 miles S of Bunker Hill		550
16	279.8	Sel.C.-1.0	Seller Creek - SE of Russell		2080
17	284.1		County Bridge - SE of Russell	680	
18	285.7	F.C.-1.4	Fossil Creek - 5 miles S of Russell		220
19	286.7		US Hwy 281 - 7 miles S of Russell	680	
20	291.2		County Bridge - 6 miles SW of Russell	650	
21	292.1	Bi.C.-2.3	Big Creek - 7 miles SW of Russell		880
22		7.4	County Bridge - 5 miles S of Gorham		41
23		14.0	County Bridge - 4-1/2 miles S of Walker		38
24		20.8	County Bridge - 5 miles S of Victoria		28
25		42.6	US Hwy 183 - SW of Hays		20
26		61.0	US Hwy 40 at Ellis		6.0
27		87.1	US Hwy 283 - 3 miles S of Wakeeney		8.0
28	296.5		County Bridge 6 miles W of US Hwy 281	180	
29	301.9		County Bridge - 10 miles S of Gorham	96	
30	314.8		County Bridge - 1 mile S of Pfeifer	60	
31	328.7		US Hwy 183 - 11 miles S of Hays	22	
32	346.3		County Bridge - 11 miles S of Ellis	16	
33	369.6		US Hwy 283 - 16 miles S of Wakeeney	16	
34	376.2	Ha.C.-35.4	Hackberry Creek - at Gove		25
35	409.4		State Hwy 23 - 1 mile East of Jerome	13	
36	430.9		US Hwy 83 at Elkader	14	
37	431.1	Lad.C.-0.1	County Bridge - SW of Elkader		11
38	456.1		County Bridge - 1/2 mile SE of Russell Springs	41	

TABLE III

CHLORIDE STUDIES - SMOKY HILL RIVER

Chloride Results from Water-Supply Paper 273 (1911)
U. S. Geological Survey

	Sampling Point		
Date	Estimated River Mile	Description	Chloride (Cl⁻) ppm
Winter 1892-93	SH-112.7	Smoky Hill below Salina	229(1)
Nov.27,1906 Nov.29,1907 (2)	SH-170.9	Smoky Hill at Lindsborg	191(3)
Sept. 16, 1907	SH-238.0	Smoky Hill at Ellsworth	461
Sept. 19, 1907	SH-292.1 Bi.C.-42.6	Big Creek at Hays	19
Sept. 20, 1907	Bi.C.-61.0	Big Creek at Ellis	15
Mar. 31, 1908	Bi.C.-61.0	Big Creek at Ellis	18
Sept. 21, 1907	SH-378.2 Ha.C.-35.0	Castle Hill Creek at Gove (Hackberry Creek)	30
Dec. 13, 1907	SH-431.1 Lad.C.-28.0	Ladder Creek at Harpers Dam, 7 miles NW of Scott City	40
Sept. 23, 1907	SH-456.1	Smoky Hill at Russell Springs	41
Sept. 23, 1907	SH-464.4 NFSH.-9.7	N.F. Smoky Hill at McAllister	30
Mar. 16, 1908	NFSH.-9.7	N.F. Smoky Hill at McAllister	15

(1) Average Result
(2) Daily samples composited over ten day period
(3) Average 191, Maximum composite 256
Minimum composite 54

TABLE IV

CHLORIDE STUDIES - SMOKY HILL RIVER

Comparison of Results of Chloride Studies Shown in Tables I, II, and III

		Chloride (Cl⁻) - p.p.m.		
		Table I	Table II	Table III
River Mile	Description	Routine Sampling 1948	Special Study Dec. 1948	U.S. G.S. 1892 - 1907
SH-112.7	Smoky Hill below Salina	86	85	229
SH-170.9	Smoky Hill at Lindsborg	119	100	191
SH-238.0	Smoky Hill at Ellsworth	427	640	461
SH-292.1 Bi.C.-42.6	Big Creek at Hays	12	30	19
Bi.C.-61.0	Big Creek at Ellis	8.5	6.0	16.5
SH-378.2 Ha.C.-35.0	Hackberry Creek at Gove		25	30
SH-456.1	Smoky Hill at Russell Springs		41	41

- -

TABLE V

CHLORIDE STUDIES - SMOKY HILL RIVER

Chloride Results and Flow at Lindsborg (River Mile SH-170.9) Jan. - July, 1907

From U. S. Geological Survey Water Supply Paper 273, and
Kansas State Board of Agriculture Report, "Stream Flow Data,
1936

Average Estimated Flow (c.f.s.)	Chloride Concentration (ppm Cl⁻)
11	251
11	246
11	251
14	179
14	216
15	154
15	235
16	192
16	164
17	174
18	190
22	242
23	169
39	103
46	191

NOTE: Where the flow varied greatly during the period of compositing samples, the results were omitted. Flows of 22 c.f.s. and above were used in computing chloride content.

indicated by its position to the plotted points, gives a good approximation of the relationship between chloride concentration and stream flow. Any point on the curve corresponds to a chloride ion discharge of 1.31 lbs. per second. This relationship will not hold at very low or very high flows (as flows approach zero, chloride concentration would become infinite). In fact, for the data shown, the relationship apparently breaks down at flows below about 25 c.f.s. at the points shown, while the upper limit of flow was not exceeded. Within these limits the coefficient of correlation is 0.95. The relatively high flows of 1948 prevented procurement of a sufficient number of samples at flows below 25 c.f.s. to ascertain the chloride-flow relationship at lower flows.

A series of composite samples from the Smoky Hill River taken at Lindsborg (SH-170.9) between November 1906 and November 1907 was reported in U. S. Geological Survey Water Supply Paper 273 (1911). Since this was prior to development of oil fields in the basin, a comparison with the results of 1948 should give an index of the amount of chloride pollution from the oil fields. Complete and accurate records of the discharge in 1906-07 are lacking, although a record of estimated discharge at Lindsborg (River Mile SH-170.9) for the period January 1907 through July 1907 is available (3) and shown in Table V. On the basis of these flows, the chloride load in 1907 was 0.34 lb. chloride ion per second, about one-fourth of the 1948 load. However, the recorded flows in 1907 were low, and since the chloride-flow relationship previously derived does not hold too well at low flows, the comparison may not be entirely just. Still, it appears certain that there has been some increase in chloride since the collection of the 1907 data.

One of the largest oil fields in this basin was discovered and developed before the Kansas State Board of Health's oil field waste disposal program was organized, and undoubtedly contributes a substantial amount to the chloride increase. (Legislation authorizing the establishment of this disposal program was not passed until 1934, but it should be noted that Kansas was one of the first of the oil producing states to pass such legislation.)

Small tributaries in the vicinity of Russell, from SH-290 to SH-275 normally have high chloride concentrations. (See Figure I).

The State Health Department has developed an active and successful brine disposal program. Gradual improvement in water quality may result in future years as the older wells are abandoned and as progress continues in the State brine disposal program. However, that amount of salt contributed by natural deposits may be expected to continue.

CONCLUSIONS

1. The Smoky Hill River above Russell County is relatively low in chloride, is high from Russell (SH-285) to Kanopolis Reservoir (SH-207), below the reservoir becomes low enough to be suitable (in this respect) for a public water supply, and is again polluted at SH-106.5 by the high-chloride water from the Saline River; the problem below this point actually being more one of the Saline than of the Smoky Hill River.

2. The principal increase in chloride content of the Smoky Hill River above its confluence with the Saline River occurs in the reach between Russell and Wilson (River Mile SH-300 to SH-250).

3. The amount of chloride entering the river above its confluence with the Saline River is approximately constant, and was equal to about 1.31 lbs. of chloride ion per second in 1948 which was almost four times the amount entering in 1907 before development of the oil fields in the vicinity of Russell, Kansas.

4. The increase in chloride content is apparently caused by oil field brines entering the river, although part of the increase may be the result of natural chloride pollution. Much of the chloride increase is probably derived from a major oil field which was discovered and developed prior to the establishment of the State Health Department's brine disposal program.

5. The State Health Department is carrying on an aggressive and successful program toward abatement of this type of pollution.

6. All chloride studies should be accompanied by flow records to be of value. (Flow data are given in this Appendix and in Appendix "H")

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1. Parker, Hortio Newton, "Quality of Water Supplies of Kansas" Water Supply Paper 273 - U. S. Geological Survey (1911).

2. Jones, Ogden S. "Disposition of Oil Field Brines" University of Kansas Publications (1945).

3. Kansas State Board of Agriculture, Report for Quarter Ending June 1936, "Stream Flow Data", P. 568.

4. Unpublished Data U. S. Geological Survey.

APPENDIX "D"

CHLORIDE STUDIES - SALINE RIVER

INTRODUCTION

Considerable attention has been focused on the salt content of the Saline River, particularly with the evolving of plans for irrigation in this Basin. Since the discovery of oil and gas fields in that part of Kansas drained by the Saline River and tributaries, the question has often arisen as to the effect of the disposal of salt brines incidental to the operation of the gas and oil wells on the chemical quality of the surface waters of this Basin.

The Saline River Basin with a drainage area of 3,425 square miles lies entirely within the State of Kansas with headwaters in Thomas County and discharges into the Smoky Hill River approximately five miles east of Salina, Kansas.

The name "Saline" apparently epitomizes the quality of the stream water encountered by the early pioneers in Kansas as the Saline River is reportedly one of the saltiest streams in the country. The salt is derived principally from saliferous shales of the Dakota formation and may be found in salt springs in the bed of the river and its tributaries.

A map of Mineral Resources of Kansas issued by the State Geological Survey, University of Kansas, depicts an extensive area underlain by salt formation in the central portion of the State reaching from the southern border northward to approximately the valley of South Fork of the Solomon River. This belt is about 150 miles wide with its eastern edge close to a line running north and south through Salina a few miles west of the confluence of the Saline and Smoky Hill Rivers. It is reported that enough salt lies beneath the plains of Kansas to cover the entire State with a layer 37 feet thick.

Although Kansas experienced oil developments in the 1870's, this industry was not important commercially until the turn of the century and then primarily in the southeastern counties. The fields in the Saline River Basin were started at a later date.

An attempt was made during the survey of water pollution in the Kansas River Basin to evaluate the chloride characteristics of the Saline River Basin and to ascertain, if possible, whether the chloride concentration was due principally to a natural condition of the stream or to contamination by salt brines from oil and gas wells.

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METHOD

Chloride determinations were made of samples from streams in the basin in an effort to determine the area of salt intrusion and to secure data for comparison with results of historical significance. It was hoped, by these means, to ascertain whether conditions have changed in the intervening years or remained comparable to the conditions prior to the development of oil fields.

Chloride determinations were made on all samples collected during the routine sampling program. Fifteen sampling stations were established in the basin from Sa.-2.4 to Sa.-268.3 and sampling carried on from April to December, 1948. Stream flow data were also obtained.

This was supplemented by a concentrated study conducted from August 9 to 13, 1948, at which time the chloride concentration at 55 stream locations was determined. This project, starting at the mouth of the river and working upstream, was developed as a continuous study to eliminate appreciable variations in stream flow. The mouths of principal tributaries were sampled and occasionally further upstream if conditions warranted. A truck was outfitted with suitable equipment to permit on-the-spot analyses for the chloride concentration.

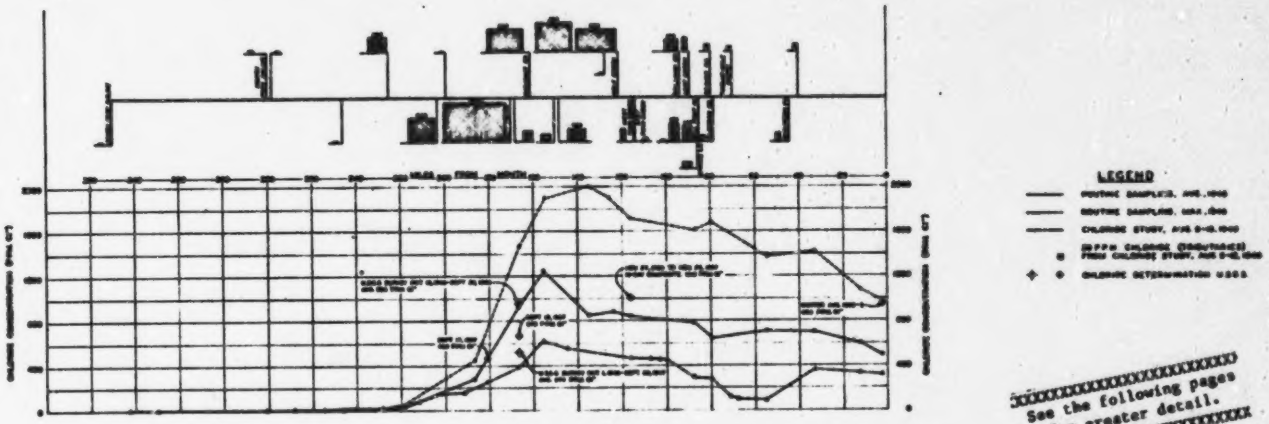
Chloride analyses for 1946 and 1947 were secured from the Water Quality Branch, U. S. Geological Survey, Lincoln, Nebraska, who made this test on several points in the basin.

Historical data were located in "Water-Supply Paper 273" by H. N. Parker, U. S. Geological Survey (1911) that listed chloride determinations made at various locations in the basin during the years 1892, 1893, 1906 and 1907. As this was prior to the oil field development, a comparison of these data with those resulting from recent studies should give an indication of any changes that may have occurred.

RESULTS

The results of the chloride determinations made in connection with the routine sampling program are shown on Table I, this Appendix, which includes station descriptions, river mile locations and average, maximum and minimum chloride analyses at these points. The average chloride content of the stream was low in the upper reaches, rose to a peak of 1245 ppm at river mile Sa.-155 and then declined to 491 ppm at the mouth. Maximum and average compilations are depicted in Figure I, this Appendix.

FIG. I (APP. D)



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See the following pages
for greater detail.
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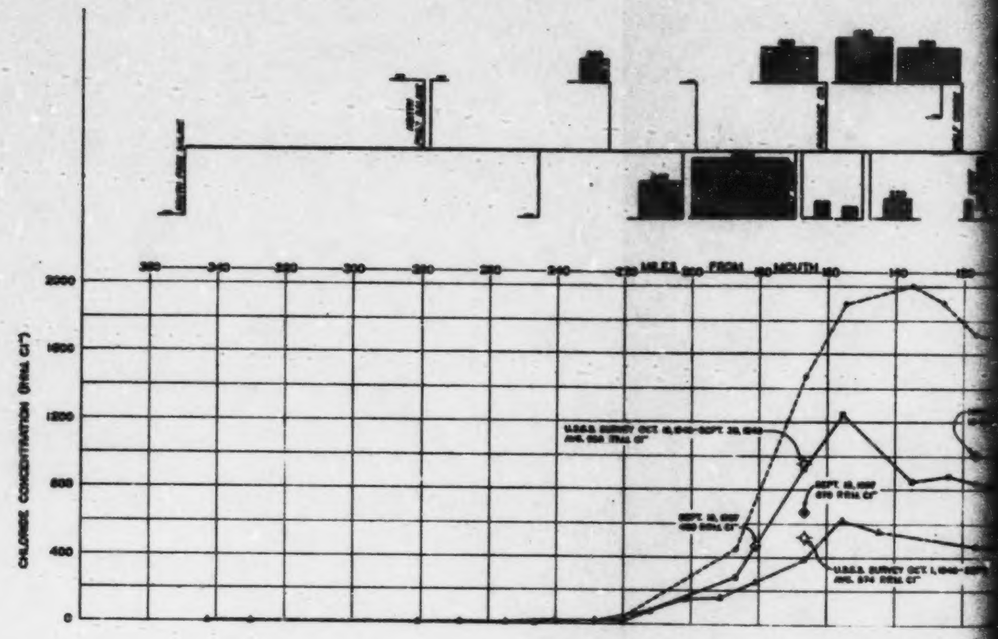
KANSAS RIVER BASIN

WATER POLLUTION INVESTIGATION

SALINE RIVER BASIN

CHLORIDE DETERMINATIONS

U. S. PUBLIC HEALTH SERVICE
1949


360
340
320
300
280
260
240
220
MILES
200
FROM
180
MOUTH
160
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120
2000
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1200
800
400
0
CHLORIDE CONCENTRATION (P.P.M. Cl⁻)
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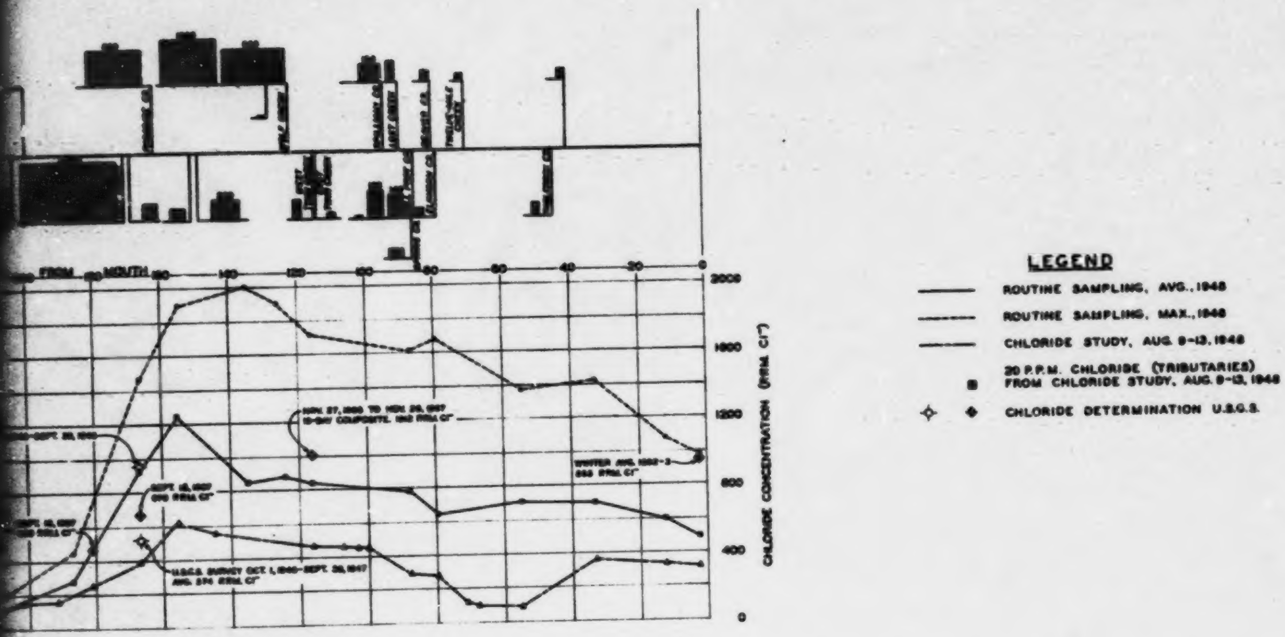
SEPT.
U.S.G.S. SURVEY OCT.

A

FIG. I (APP. D)



KANSAS RIVER BASIN
WATER POLLUTION INVESTIGATION
SALINE RIVER BASIN
CHLORIDE DETERMINATIONS
U. S. PUBLIC HEALTH SERVICE
1949

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201-a

TABLE I

CHLORIDE STUDIES - SALINE RIVER

Chloride Results of Routine Sampling During 1948

Summary of Results

No. of Samples	Sampling Points		Chloride (Cl^-) ppm		
	River Mile	Description	Max.	Avg.	Min.
16	Sa- 2.4	Bridge - U.S. 40 east of Salina	986	491	16
17	12.2	U.S. Hwy. 81 - 2 miles north of Salina	1082	608	57
17	35.2	County Road - South of Culver	1432	712	80
17	54.5	County Road - South of Tescott	1380	735	40
11	79.5	County Road at Rocky Ford	1684	644	32
17	87.4	State Hwy. 14 at Lincoln	1626	781	22
14	116.2	Bridge at Sylvan Grove	1724	847	40
14	124.2	County bridge 3 miles west of Sylvan Grove	1886	881	58
14	135.0	Bridge - 1 mi. E., 8 mi. S. of Lucas	2002	852	35
3	155.8	County road 7 miles N. of Bunker Hill	1894	1245	604
5	166.6	U.S. Hwy. 4 miles N. of Russell	1472	932	64
3	186.9	Bridge - 2 miles east of Fairport	444	284	172
4	220.1	U.S. Hwy. 183 - 15 miles N. of Hays	40	30	21
3	240.3	State Hwy. 18 - 11½ miles N. of Ellis	31	24	18
4	268.3	U.S. Hwy. 283 - 5 miles N. of Wakeeney	15	11	4.1

Table II contains the summary of the study conducted August 9 - 13, 1948, with chloride analyses of 55 stream samples. In general, these studies indicate that at Sa.-350 the chloride content was less than 10 ppm and reached 30 ppm at Sa.-250. An unnamed creek discharged to the Saline River at river mile Sa.-225 with a chloride content of 260 ppm while at Sa.-203, another creek discharged water having a concentration of 640 ppm. The salinity of the river increased gradually to about 260 ppm at Sa.-180. Salt Creek enters at Sa.-169.9 with 2,450 ppm chloride and Paradise Creek at Sa.-160.4 with 800 ppm. The maximum chloride concentration in the Saline River was 620 ppm at Sa-155.8. At Sa.-121.4 Wolf Creek had a chloride concentration of 1,050 ppm. The chloride concentration of the river then declined gradually and all tributaries showed a lower value than the main stem. Although a dip occurred at Sa.-54.5 to a minimum of 100 ppm, the river discharged to the Smoky Hill River with a chloride concentration of 320 ppm. These data have been plotted on Figure I.

Data secured from Water Supply Paper 273 (1911) U. S. Geological Survey have been compiled as Table III. Estimated river mileages have been presented to afford comparison with other tabulations.

The chloride determinations at Sa.-166.6 made by the U. S. Geological Survey during 1945 - 1947 are compiled in Table IV and also shown in Figure I.

The comparison of these data collected from similar stations is depicted in Table V and Figure I. It appears that in all instances, a similar trend exists showing a low chloride concentration above Sa.-220, a peak in the vicinity of Sa.-150 and then a gradual decrease in concentration to the mouth.

DISCUSSION

It was apparent while analyzing the data that the chloride concentration varied inversely with the flow making it necessary to correlate all laboratory information with momentary stream discharge to accurately depict actual conditions. To illustrate this characteristic, experimental data collected during the year 1948 at station Sa.-116.2 and Sa.-166.6 were analyzed and the curves derived by the method of averages. These data are illustrated in Figures II and III. Analyses of these data indicated a coefficient of correlation between chloride concentration (ppm) and stream discharges (c.f.s.) of 0.93 for the data shown in Figure II and 0.89 for the data in Figure III. The hyperbolic curves obtained and the excellent correlation between the calculated and experimental data indicate that the chloride discharge of the stream (lbs. per sec.) at the

TABLE II

CHLORIDE STUDIES - SALINE RIVER

August 9 - 13, 1948

Summary of Results

Sampling Points				Chloride (Cl^-) - ppm	
	River Mile				
No.	Main Stem	Tributaries	Description	Main Stem	Tributaries
1	Sa- 2.4		Bridge - U. S. 40, East of Salina	320	
2	12.2		U.S. Hwy. 81 - 2 miles N. of Salina	340	
3	35.2		County road South of Culver	380	
4	40.0	x C.-1.2	Creek 2 miles West of Culver		30
5	44.0	TRC.-1.1	Table Rock Creek - East of Tescott		38
6	54.5		County road South of Tescott	100	
7	67.9		County road SW of Beverly	110	
8	70.0	Tw.M.C.-0.2	Twelve Mile Creek - East of Shady Bend		20
9	71.3		County road S. of Shady Bend	124	
10	78.5	El.C. -1.0	Elkhorn Creek		28
11	79.5		County road at Rocky Ford	240	
12	79.6	Be.C.-0.9	Beaver Creek - East of Lincoln		30
13	84.9	Bul.C.-2.0	Bullfoot Creek - South of Lincoln		140
14		Bul.C.-6.4 Sp.C-0.3	Spring Creek - Southwest of Lincoln		62
15		Bul.C.-7.2	Bullfoot Creek - Southwest of Lincoln		160
16		Bul.C.-8.4	Bullfoot Creek - Southeast of Vespers		2
17	87.4		State Highway 14 at Lincoln	300	
18	89.0	LC.-2.1	Lost Creek - 1 mile West of Lincoln		60
19	93.7	Spl.C.-1.6	Spillman Creek - 3½ miles West of Lincoln		150
20	100.0		4 miles West of Lincoln	460	
21	103.4		3/4 mile South of Vespers	460	
22	107.5		County road Southwest of Vespers	464	
23	113.8	ETC.-0.9	East Twin Creek - SE of Sylvan Grove		14
24	114.0	WTC.-0.9	West Twin Creek - S. of Sylvan Grove		58
25	116.2		Bridge at Sylvan Grove	470	
26	121.4	Wo.C.-4.0	Wolf Creek - 4 miles W. of Sylvan Grove		900
27		Wo.C.-5.4 x C.-2.1	Creek - SE of Lucas		4
28		Wo.C.-8.2	Wolf Creek - 1 mile E. of Lucas		1050
29	145.0		County road - 6 miles N. of Dorrance	556	
30	148.0	x C.-0.3	Creek- Northeast of Bunker Hill		230
31	150.1	x C.-0.1	Creek - 5 miles N. of Bunker Hill		70
32	155.8		County road 7 miles N. of Bunker Hill	620	

TABLE II (Continued)

CHLORIDE STUDIES - SALINE RIVER

August 9 - 13, 1948

Summary of Results

Sampling	Points			Chloride (Cl⁻) - ppm	
No.	River Mile Main Stem	River Mile Tributaries	Description	Main Stem	Tributaries
33	Sa 160.4	Pa.C.-0.3	Paradise Creek - NE of Russell		800
34	166.6		U. S. Hwy 281 - 4 miles N. of Russell	390	
35	167.9	x C.-2.0	Creek - Northwest of Russell		100
36	169.9	Sa.C.-2.0	Salt Creek - 4 miles NW of Russell		2450
37	181.0		County road - SE of Fairport	260	
38	191.5		West of Fairport	160	
39	199.0	x C.-0.2	Creek - 9 miles NE Emmeram		0.4
40	202.0		10 miles NE Emmeram	160	
41	205.0	x C.-0.4	Creek - 12 miles NE of Catherine		640
42	212.0		12 miles NW of Catherine	80	
43	225.0	x C.-0.2	Unknown Creek		260
44	229.0		12 miles N. of Yocemento	30	
45	240.3		State Hwy 18 - 11 miles N. of Ellis	30	
46	246.0	x C.-0.2	Creek - 13 miles NE of WaKeeney		4
47	246.5		County road 14 miles NE of WaKeeney	30	
48	255.0		County road NE of WaKeeney	6	
49	278.0	x C.-0.5	Creek NE of Voda		10
50	268.3		U. S. Hwy 283 - N. of WaKeeney	16	
51	280.0	NFSa.-4.0	N.F.Saline - 3/4 mile S. of St. Peter		12
52	281.0		County Road - 1 mile E., 5 miles N. of Collyer	10	
53	330.0		State Hwy 23 - 13 miles S. of Hoxie	4	
54	343.0		County road 1 mile S. of Angelus	6	
55	350.0	SFSa.-3.0	U. S. Hwy. 383 - 1 mile N. of Oakley		4

TABLE III

CHLORIDE STUDIES - SALINE RIVER

Chloride Results from Water-Supply Paper 273 (1911)
U. S. Geological Survey

	Sampling Point		
Date	Estimated River Mile	Description	Chloride (Cl^-) ppm
Winter 1892-3	Sa.- 2.4	Saline River above New Cambria	858 (1)
Nov.27,1906 Nov.29,1907 (2)	Sa.-116.2	Saline River at Sylvan Grove	1012 (3)
Sept. 9, 1907	Sa.-121.4 Wo.C.-8.2	Wolf Creek at Lucas	2188
Sept. 18, 1907	Sa.-166.6	Saline River below Salt Creek - North of Russell	670
Sept. 18, 1907	Sa.-169.2 Sa.C.-2.0	Salt Creek North of Russell	3270
Sept. 18, 1907	Sa.-181.0	Saline River above Salt Creek - North of Russell	469

(1) Average result

(2) Samples composited every ten days

(3) Maximum 10-day composite 1580
Minimum 10-day composite 224
Average 10-day composite 1012

TABLE IV

CHLORIDE STUDIES - SALINE RIVER

Chloride Results from U. S. Geological Survey
Water Resources Branch, Lincoln, Nebraska
1945 - 1947

	Sampling Point		
Date	Estimated River Mile	Description	Chloride (Cl⁻) ppm (1)
10-16-45 (2) 9-30-46	Sa. - 166.6	U. S. Hwy 281 - 4 miles N. of Russell	955 (3)
10-1-46 (2) 9-30-47	Sa. - 166.6	U. S. Hwy 281 - 4 miles N. of Russell	524 (4)

(1) Average Results

(2) Samples composited every ten days

(3)	Maximum 10-day composite	2120
	Minimum 10-day composite	280
(4)	Maximum 10-day composite	1750
	Minimum 10-day composite	52

TABLE V

CHLORIDE STUDIES - SALINE RIVER

Comparison of Results of Chloride Studies Shown in Tables I, II, III, & IV

	Chloride (Cl⁻) - ppm			
River Mile	Table I Routine Sampling 1948	Table II Special Study Aug. 1948	Table III U.S. G.S. 1892 - 1907	Table IV U.S. G.S. 1945 - 1947
Sa. - 2.4	491	320	858	
Sa. - 116.2	847	470	1,012	
Sa. - 121.4 No.C.-8.2		1,050	2,188	
Sa. - 166.6	932	390	670	955 524
Sa. - 169.2 Sa.C.-2.0		2,450	3,270	
Sa. - 181.0	284*	260	469	

*Mile Sa.-186.9

TABLE I - Average of Routine Sampling During 1948

TABLE II - Spot Samples August 9 - 13, 1948

TABLE III - Spot samples and averages from Water-Supply Paper 273 (1911) U. S. Geological Survey

TABLE IV - Averages from U. S. Geological Survey 1945 - 1947

FIG. II CHLORIDE STUDIES—SALINE RIVER

RELATIONSHIP OF CHLORIDE CONCENTRATION (PPM)
AND STREAM DISCHARGES (C.F.S.)
AT SA-116.2

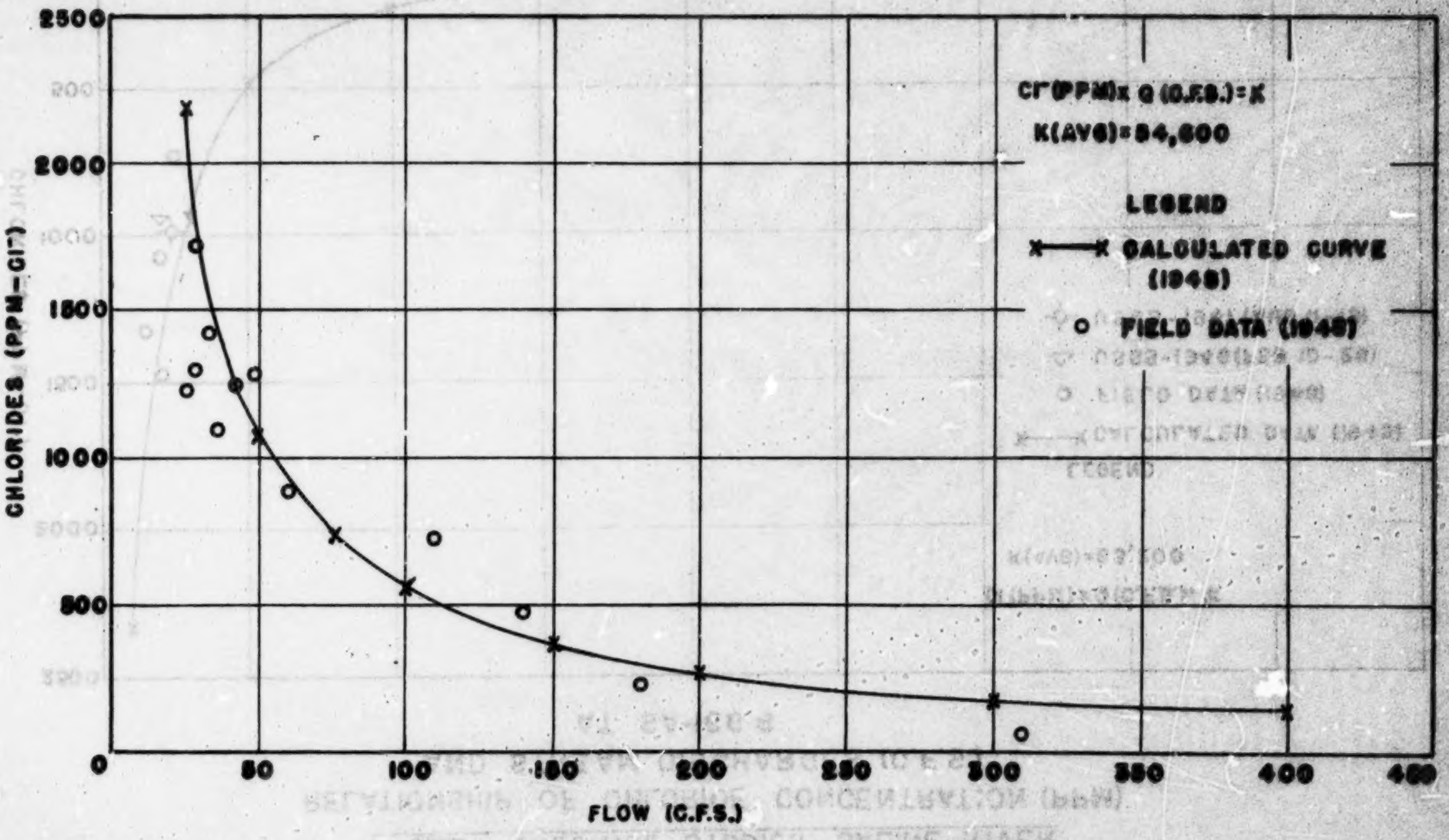
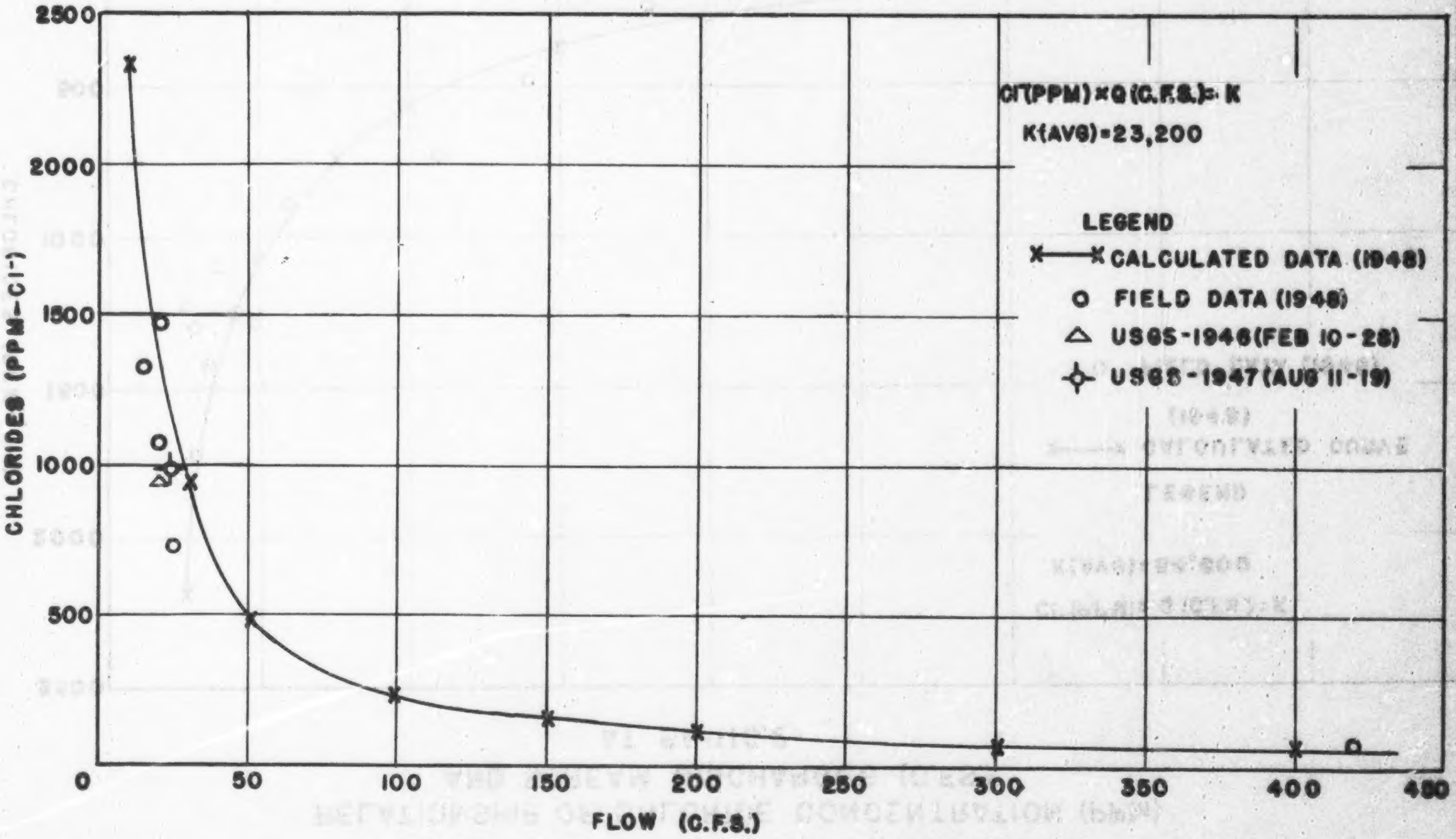


FIG. III CHLORIDE STUDIES—SALINE RIVER

RELATIONSHIP OF CHLORIDE CONCENTRATION (PPM) AND STREAM DISCHARGES (C.F.S.) AT SA-166.6



respective stations is nearly constant. This means that when the flow doubles the chloride concentration (ppm) is reduced by one-half or that the chloride concentration (ppm) is inversely proportional to flow. Apparently, the chloride is fed from a rather constant source and diluted by water which is relatively salt free.

Unfortunately, stream discharge measurements are not available for the studies conducted by the U. S. Geological Survey in 1907. However, an attempt was made to obtain a correlation between these and other results by comparing yearly precipitation records for the State of Kansas. The following is presented:

Climatic Year	Station	Source of Date	Annual Precipitation in Inches	Mean Discharge c.f.s.	Cl^- (ppm)
1907*	Sa.-116.2	USGS - 10 day Composites (1)	26.46	-	1012
1946	Sa.-166.6	USGS - 10 day Composites (3)	22.71	41.3	955
1947	Sa.-166.6	USGS - 10 day Composites (3)	30.24	216	524
1948	Sa.-166.6	average of 5 Samples	30.57	79.3	932
1948	Sa.-116.2	Average of 14 Samples	30.57	-	845

* 1907 a Calender Year

It may be observed that mean stream discharges do not necessarily vary with precipitation.

It was noted during the current survey that turbidities in most instances varied with stream discharge. As the 1907 data included turbidity measurements, it was felt that this presented an opportunity to correlate present chloride determinations with those obtained in 1907. To eliminate exceptionally high turbidities caused by high run-off and collected in grab samples, only those samples showing turbidities of 100 ppm or less were used. This resulted in an average turbidity of 48 ppm in 1907 and 43 ppm in 1948 with 1167 ppm and 1252 ppm chloride, respectively. Based on the assumption that the flows during this period would be comparable, it appears that the chloride content of the stream during normal discharge periods has not changed appreciably in the intervening years.

A general review of Figure I would also indicate that the chloride concentration of the stream during 1948 was similar to that during 1907. At mile Sa.-116.2, the average of 10-day composites collected from November 1906 to November 1907, was 1,012 as compared with 847 resulting from an average of 14 routine samples collected over a period from April to December, 1948. It is of particular interest to note the high chloride concentration in tributaries during 1907 as recent tests indicated a much lower salt concentration (Table V).

To ascertain recent trends, a comparison was made of selected data at similar flows for the years 1946, 1947, and 1948 as follows:

Comparison of Selected Chloride Data
Collected at Comparable Stream Discharges - Sta. Sa.-166.6

Data	Stream Discharge c.f.s.	Chloride Concentration ppm	Chloride Discharge lbs./sec
USGS Feb. 20-28,1946	21.5	945	1.27
USGS Aug. 11-19, 1947	24.6	948	1.46
This Survey Sept. 21 & Nov. 2, 1948	20	1266	1.58
Dec. 8, 1948	25	736	1.15
Calculated - 1948 (Figure III)	25	930	1.45
Average			1.38

The chloride content in pounds per second in the stream varies only slightly from the average and lies within the range of experimental error. Apparently, little change if any, has occurred recently in the chloride content of the Saline River (See Figure III). The fairly constant chloride content of the Saline River over these years reflects the active program for salt brine disposal by the Oil Field Section of the Kansas State Board of Health and the likelihood that formation salts entering the stream have remained relatively constant during this period.

The chloride discharged by the Saline River may be estimated quite readily from the constant derived for the curve in Figure II, and will amount to about 3.4 pounds per second or about 147 tons per day, at Sa.-116.2, which is below the reach from which most salt is obtained.

The lack of discharge data is obviously one of the great weaknesses of stream investigations. Results of laboratory tests are of little value when dealing with such a variable as stream flow unless discharges at the time of sampling are secured. Comparing grab samples composited over a period with individual or groups of individual results is questionable as peak flow, low run-off and other variations may unduly influence composite samples.

SUMMARY AND CONCLUSIONS

A study was made to determine the chloride characteristics of the Saline River and to determine the influence of possible discharges of salt brines incidental to the development of oil and gas fields. The method was to compare laboratory data collected during the present study of the Kansas River Basin with that previously collected by the U. S. Geological Survey, particularly that secured during 1907. Conclusions are as follows:

1. The chloride concentration of the Saline River is low in the upper reaches, increases rapidly at river mile Sa-180, reaches a peak at approximately Sa-155, and then declines to the mouth of the stream.

2. The chloride apparently reaches the stream from a constant source originating between mile Sa-200 and mile Sa-120, and totals about 147 tons of chloride ion per day.

3. Chloride characteristics of the Saline River as reflected by this survey during 1948 appear similar to those reported in 1907, 1946, and 1947.

4. The development of oil and gas fields in this area apparently has not increased appreciably the chloride concentration of the Saline River and reflects the activity of the Oil Field Section of the Kansas State Board of Health.

5. Discharge data at time of sampling is essential to the proper evaluation of laboratory data. (Flow data are given in this Appendix and in Appendix "H")

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APPENDIX "E"

WASTES FROM POULTRY DRESSING ESTABLISHMENTS

SUMMARY

Studies were made over the operating cycle of several poultry dressing establishments to develop unit pollutional factors.

The following are based upon the results of investigations and laboratory analyses of wastes from these plants:

Type of Process	Population Equivalents per 1000 lbs. Live Weight	
	B.O.D.	Suspended Solids
New York Pack - no manure most blood saved	25	20
Manure per day	55	50
Blood	30	-
Evisceration and final pack	15	5

INTRODUCTION

Engineering investigations of pollutional discharges from industrial establishments require an understanding of plant operation and standards by which the quantity and quality of wastes may be evaluated. The paucity of information regarding the wastes discharged from the processing of poultry, an industry based upon the farm economy of various sections of this country and frequently encountered in the Kansas River Basin, made it imperative that studies be conducted for the development of production unit pollutional factors.

METHOD

Detailed studies were made over the operating cycle of several plants to secure information relating to production and waste characteristics so that the unit factors could be developed.

Selected plants were contacted by a representative of the State Health Department and the engineer in charge of the survey at which time pertinent information such as production figures, water consumption and plant operation was collected from plant officials and operating personnel. The feasibility of sampling was investigated and where necessary discharge lines were cleaned, additional valves and meters installed and extra records developed for the study.

The usual procedure was to establish a flow gaging station, installing a weir whenever possible, and checking waste discharges with meter readings. Survey personnel were then assigned specific posts and duties so that meters, weir readings or flow measurements, and sampling were coordinated at fifteen minute intervals throughout the entire period of operation. Individual samples were composited according to flow to secure a representative discharge and stored in an iced container throughout the sampling period and during time of travel to the laboratory.

Laboratory analyses consisted of the following determinations:

1. pH value
2. Biochemical oxygen demand (Standard 5-day 20°C)
3. Suspended Solids (total, fixed, and volatile)
4. Turbidity
5. Chlorides
6. Alkalinity

DESCRIPTION OF PROCESS

Poultry dressing establishments act as receiving stations for the birds, provide for their slaughtering and dressing, and complete the process by packing them according to the mode of operation.

The plants studied employed from 7 to 51 workers and operated from 4 to 7.5 hours per day. Normal operation, provided enough birds are on hand, is an eight-hour day plus one or two hours for clean-up.

At the start of operations the poultry batteries are taken from an adjoining storage space to where the birds are removed and suspended from shackles on an endless chain leading to the killing floor. After being stuck, they pass through a scald tank and then to the roughing machines which remove the feathers. Several types of roughing machines are employed differentiated by the portion of the bird that is being cleaned, such as neck, leg, and wing machines. Some plants utilize a wax dip for the removal of the finer and pin feathers; the birds being dipped into a hot wax tank, cooled by a water spray and the wax and feathers removed by hand. The wax is then heated, filtered and re-used. Following this the birds are hand picked and may then pass through a singer following which they are washed.

With the so called "New York Pack" the birds are packed without evisceration while "Full Pack" provides for the removal of entrails, washing the birds and final packing.

PRODUCTION

Poultry will vary on the average from 4 to 4.5 pounds per bird; the average of the four plants studied being 4.35 pounds. This compares to 4.5 pounds per bird reported in the Industrial Waste Guides of the Ohio River Pollution Survey. The birds will dress "New York Pack" about 1/2 pound less, an average shrinkage factor of 12.1%. Shrinkage for "Full Pack" will vary from 20 to 22%.

These data are tabulated as follows:

TABLE I

Weight of Birds, Live & Dressed

	Avg. Wt. per Bird in lbs.			Shrinkage.		
Plant	Live	N.Y.Pack	Full Pack	Lbs.	Per cent	Remarks
A	4.35	3.73		0.62	14.3	
B	4.0 (1)	3.52 (2)		0.48	12.0	
C	4.58		3.66	0.92	20.0	
D	4.45	4.00		0.45	10.1	4.5 lbs. Ohio Pollution Survey
Average	4.35					

(1) Springer - 3.18 lbs.
Fowl - 4.95 lbs.

(2) Springers - 2.76 lbs.
Fowl - 4.40 lbs.

The number of employees per unit production is presented in Table II. An average of 14.5 employees may "New York Pack" 10,000 pounds of birds per day.

TABLE II

Number of Employees per Unit Production

Plant	Type of Process	Employees per 10,000 lbs. Live Weight/day
A	N. Y. Pack	13.1
B	N. Y. Pack	14.5
C	Full Pack	26.4
D	75% N. Y. Pack 25% Full Pack	15.8
Ohio River Pollution Survey		60.0

SOURCES OF WASTE

Wastes are produced from the storage of live birds and the processing of the fowl.

Receiving

The birds are usually kept in storage overnight or until sufficient numbers are received to permit a day's operation. Wastes consist of manure from the batteries, waste feed make-up and floor washings. Many plants eliminate manure from stream pollution considerations by trucking it to a dump but others clean the batteries by scraping the accumulations to a sump and flushing them to the sewer.

Killing Floor

Most plants allow the blood to coagulate permitting its removal, after completion of operations, to a dump, to a rendering plant or to be sold or given away for fish bait. Obviously, some blood in all plants reaches the sewer while a few establishments dispose of it all in that fashion.

Scald Tank

The scald tank is made up with boiling water prior to operations and maintained at that temperature. A constant stream of water enters the tank and overflows usually to a floor drain. As the fowl are passed through the tank after being stuck, blood and miscellaneous matter is caught. The vat is dumped at the end of the operating day and discharges a highly polluting waste.

Roughing Machines

The roughing processes operate with continuous sprays discharging to floor drains.

Waxing

Some plants use a wax dip to assist in removing feathers. The bird is dipped into hot wax, cooled by water spray and the wax and feathers removed by hand. The wax is reheated, feathers removed, and reused. The feathers are dumped in most instances. Wastes consists of wax and feathers escaping inadvertently.

Evisceration

When poultry is drawn, blood, bits of fat and meat scraps are washed to waste. Obviously, entrails should never be discharged to sewers although this practice may be encountered occasionally.

Miscellaneous

The crop is milked by puncturing this organ and removing its contents. Usually the waste drops to a container to permit easy removal, although occasionally this waste may reach the sewer.

Wash waters and clean-up of equipment and floors may also discharge considerable wastes.

Quantity of Waste

The volume of combined wastes from the various plants is shown in Table III.

CHARACTER OF WASTES

The analyses of combined wastes are shown in Tables III and IV. It may be noted that the wastes are several times the strength of domestic sewage. The alkalinity and chloride analyses are not shown in Table IV since these substances in the water supply overshadow the amount produced during the process.

TABLE IV

Laboratory Analyses

		Suspended Solids				
Plant	B.O.D.	ppm	Volatile	Fixed	pH	Turbidity
A	997	960	820	140	7.1	1100
B	1475	1520	1120	400	7.5	2200
C	1070	1052	932	120	7.6	900
C	1560	640	490	150	6.7	500
D	290	502	406	96	7.6	500

Receiving

The discharge to sewers of manure from receiving and feeding stations is the largest single source of pollution from poultry dressing establishments. However, this source of pollution may readily be eliminated by removing the material and dumping or returning it to the farms as fertiliser.

Plant A and Plant B (Table III) had similar operational methods with the exception that the latter plant wasted manure to the sewer.

TABLE III

Poultry Dressing Wastes

Operation	Unit	Waste Flow Gals. per Unit	Analyses		Sewered Population Equivalent per Unit		Remarks
			B.O.D.	Sus. Solids	B.O.D.	S. Solids	
Plant A N.Y. Pack	1000# live wt.	435	997	960	22	17	Most blood saved
Plant B N.Y. Pack	1000# live wt.	1850	1475	1520	136	117	Cooling water 2 day's manure to sewer - Most blood saved
Plant C N.Y. Pack	1000# live wt.	545	1070	1052	29	23	Some blood to sewer
Plant C Evisceration & Packing	1000# live wt.	202	1560	640	14	5	Kill shown above drawn
Plant D 75% N.Y. Pack 25% Full Pack	1000# live wt.	1150	290	502	17	24	Cooling water Minimum of blood
	1000# live wt.	2200	2730	1460	300	160	Ohio River Pollution Survey
Blood	1000# live wt.	6.7	90000		30		Volume estimated

On the day of testing, approximately 2-days' accumulation of manure was discharged resulting in an increase of about 110 in the the population equivalents per 1000 pounds live weight. Thus it appears that the manure each day from 1000 pounds of birds will approximate a population equivalent of 55.

Killing Floor

The blood from the killing of the birds appears as the second largest source of pollution. Approximately 8% of the body weight of chickens may be blood of which possibly 70% will drain. Therefore, for each 1000 pounds killed, 56 pounds of blood will be discharged. The B.O.D. of chicken blood was determined as 90,000 ppm (Table III) and results in a population equivalent of 30 per 1000 pounds live weight.

Catching the blood for disposal by other means will eliminate this important pollutional factor. Many plants remove the blood that coagulates and thereby eliminate a good portion of this waste.

Scald Tank

The scald tank receives considerable blood, some manure and miscellaneous dirt that may wash from the feathers. These tanks have a constant overflow and are dumped at the end of the day.

The pollution from this tank could be reduced by extending the time that the blood is allowed to drain from the birds.

Roughing Machines

The waste from roughing machines contains some dirt and feathers. Adequate screening on floor drains will prevent most of this material from reaching the sewer.

Waxing

Occasionally, difficulty has been experienced with wax and feathers reaching the sewers. Although the B.O.D. may not be increased appreciably, clogging of sewers and appurtenances occurs.

Evisceration

The opportunity developed at one plant to secure separate wastes from the evisceration process; results indicated a population equivalent of 14 per 1000 pounds live weight.

Sewered Population Equivalents

Table III shows the sewered population equivalents for the plants surveyed and a figure obtained from the Industrial Waste Guide - Ohio River Pollution Survey. These are based upon a per capita discharge per day of 0.167 pounds 5-day 20°C B.O.D. and 0.2 pounds of suspended solids.

From Table III, the following population equivalents appear reasonable:

Type of Process	Population Equivalents per 1000 lbs. Live Weight B.O.D.	Population Equivalents per 1000 lbs. Live Weight Suspended Solids
New York Pack - no manure, most blood saved	25	20
Manure per day	55	50
Blood	30	-
Evisceration & final pack	15	5

The above figures will provide tentative standards, pending additional studies, for the evaluation of Poultry Dressing Plants.

POLLUTIONAL EFFECTS

It would appear that poultry dressing wastes are similar to those normally encountered at slaughter houses and meat packing plants and that similar treatment devices would take care of these wastes. Oxygen depletion, sludge deposition, and coloration are the principal effects of these wastes on receiving bodies of water.

ACKNOWLEDGMENT

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Health Engineer R. M. Babcock, Nebraska State Health Department and Sanitary Engineers Geo. A. Hussey and R. D. Lee, Kansas State Board of Health.

Analyses were conducted by a Public Health Service field laboratory and the Kansas State Board of Health Laboratory at Lawrence, Kansas.

Cooperation by industry in all instances was excellent.

APPENDIX "F"

PARTIAL REVIEW OF LITERATURE ON PUBLIC HEALTH ASPECTS OF IRRIGATION WITH SEWAGE POLLUTED WATER

1. Davidson (1), according to Wilson (9), reports an outbreak of typhoid and paratyphoid fever involving 65 cases in North Battleford, Saskatchewan, Canada, during the summer of 1941. Neither milk nor water could be incriminated as the agent of transmission. Inconclusive evidence indicated that the infection was spread by vegetables which were irrigated, and possibly washed, with water from a ditch into which the sewage works discharged its effluent.

2. Chapman (2), stresses the need for treatment of sewage discharged to streams from which water is taken to irrigate market produce. Investigations conducted by the Colorado State Board of Health have shown that vegetables, grown in fields many miles below the source of the pollution, contained large numbers of colon bacilli. In many instances washing could not make them fit for human consumption. Some epidemiological evidence is presented. The death rate for typhoid fever, also for diarrhea and enteritis in infants up to 2 years of age, in Colorado is high when compared to that for the U.S. and several other western states. Colorado counties having polluted waters have death rates for the above infections almost twice those of counties in which there is little or no pollution of streams. Maps are presented which show the grossly polluted streams are closely associated with the counties having these higher death rates. Water and milk were not considered the infection source. It was recommended that fruits and vegetables grown under or close to the ground should not be irrigated with sewage polluted water. Although cooking may make eating such vegetables safe, it does not eliminate the possibility of introduction of infectious matter into the kitchen and its transfer to foodstuffs.

3. Lumsden and Anderson (3), in their investigation of the origin and prevalence of typhoid fever in the District of Columbia, found (3a) "a suggestively large portion of the typhoid cases in the District of Columbia had eaten lettuce, celery or strawberries during the 30 days prior to illness." They experienced difficulty in tracing the produce back to its source and therefore considered definite conclusions "not justifiable". They conclude (3b), however, that "In view of the insanitary conditions, particularly in respect to the lack of sanitary privies on farms which supply a large portion of the green vegetables and fruits distributed in Washington, it seems quite probable that those foodstuffs play some part, and for occasional periods perhaps a very considerable part, in the distribution of typhoid-fever infection in the District of Columbia".

Furthermore, they recommend (3c), "The enactment of legislation prohibiting the sale or the offering for sale in the District of Columbia of . . . any green garden truck obtained from farms not provided with either sanitary privies or sanitary water-closets".

4. Bundsen (4), reports that following a typhoid outbreak in Chicago, which was eventually traced to oyster infection, special effort was made to determine the sources of certain vegetables, lettuce and watercress, served in hotels and restaurants, where it appeared the majority of cases had contracted the infection. This was found to be impossible; there was no common source for such produce. In connection with the investigation bacteriological examination of fruits,vegetables and watercress was undertaken. E.coli bacteria were found but whether of human or other source was not determined. In one case high coli contamination of lettuce was traced to the ice in which it was packed. Need for greater attention to watercress is stressed. In the discussion of Bundsen's paper Dr. F. C. Johnson, a pediatrician, comments that based on his experience he has "advised not to feed lettuce or celery to children as the possibility of infections being carried by these raw vegetables is really great."

5. In the discussion (5) of Dr. Warrys report of an outbreak of enteric disease involving 110 cases in the borough of Hackney, England, it is noted that a high per cent of the cases had partaken of watercress within 3 weeks prior to the illness, and bacteriological examination of beds from which the watercress had been taken showed the presence of sewage organisms, in one case, as high as 50 E. coli bacteria per cubic centimeter of water.

6. An article in the Journal American Medical Association (6) notes the raising of vegetables, frequently eaten raw, on the Paris, France sewage farm and associates the occurrence every year, from July to October, of typhoid fever in Paris with the marketing of these vegetables. "Clauditz found germs, after several days, on green herbs thus treated which a thorough washing could not remove. Dr. E. Marchoux, after an investigation, 'recommended that the kinds of herbs and vegetables that may be grown on sewaged land be established by law.'"

7. The American Society of Civil Engineers' committee on salvage of sewage (7) notes that in 1934 the directors of public health in each of the 48 states and the District of Columbia were asked for information on the extent of sewage use for irrigation. Only 9 states, of the 40 replies received, admitted having experience with sewage irrigation and sewage irrigated crops. Significantly, "four were able to trace illness of an epidemic order to such use, whereas one other stated that cattle, pastured on a raw sewage irrigated field developed

poorly and were infested with Cysticercus bovis". At that time (7a) "Only one of the nine was agreeable to the use of (sewage) treatment plant effluent on vegetables to be eaten raw", and that state prescribed practically potable water standards for such effluent. In summarizing the committee states (7b) "Thus it would appear that, except for use upon vegetables to be eaten raw, an effluent from about that afforded by subsidence, trickling filters, and secondary subsidence effecting about 85% reduction in biochemical oxygen demand (B.O.D.) and suspended solids, followed by chlorination, should satisfy health requirements..."

8. Roberts (8) noted 23 of 45 cattle fattened on the Tucson, Arizona, sewage farm were upon slaughtering found infested with the tape worm, Cysticercus bovis. Since these cattle apparently came from different sources -- they all bore different brands - and such general infestation indicated a source common to all or most of them, it was concluded that the infestation resulted from drinking sewage polluted water.

9. Wilson (9) cites the experience at the Melborne, Australia, sewage farm where in 1937, 46% of the cattle grazed were found infested with Taenia saginata. The sale of these cattle was banned. During a six month survey of Melborne (1941-42) 100 cases of human tape worm infections were treated. He concludes, "In ... any town where large portions of the inhabitants are infested with tapeworm ... sewage and sewage sludge must present a real danger."

10. Under Annotations (10) it is noted that Leptospirosis is essentially an occupational disease. Human infection is acquired through the alimentary tract or by contact with contaminated water or other material. It has occurred "during the last few years among ... sewer workers in London and Glasgow ..., and workers in the beet fields in Ireland, who are probably infected through abrasions of the hands in the same way as are the sugar cane cutters in Queensland".

11. Mills et al. (11) conducted laboratory investigations to determine whether the bacteria penetrated the surface of fruits and vegetables. They found that although bacteria do not penetrate the uninjured surface, they may gain entrance through damaged or decayed surfaces and remain viable for from 7 to 42 days. They also demonstrated that bacteria may persist on the surface of fruits or vegetables kept moist for 15 or more days.

12. Kligler (12) investigated the survival and dispersion of typhoid and dysentery bacilli in soil. These bacteria were recoverable from artificially inoculated moist soil (pH 6.6-7.4) for 70 or more days, but were not recoverable in dry soil on the 20th day. They penetrated to a depth of 2, but not 3, feet in 40 days in relatively porous soil under a 1 to 2 inch head of water.

13. Melick (13) in three outdoor experiments, extending from May to September, isolated typhoid bacteria from garden soil 41, 34 and 35 days after inoculation with typhoid bearing excreta. Under hot house conditions old strains of typhoid bacteria survived for 74 days in garden soil enriched with sterile sewage; fresh strains survived only 49 days. In these experiments typhoid bacteria were found on radishes grown in infected soil 37, 28 and 35 days, and on lettuce after 21 days, after inoculation of the soil. The organism became attached to the surface and was not ordinarily removable by washing.

14. Creel (14) investigated the viability of typhoid bacilli on garden truck. He reports 3 experiments in which radishes and lettuce were raised on soil sprinkled with a fecal emulsion mixed with 24-hour old culture of typhoid bacilli 2 or 3 days after the planting.

He states, "that plants cultivated in contaminated soil will take up on the leaves and stems, as they grow through the soils, organisms existing therein."

"The Bacillus typhosus (typhoid bacillus) was recoverable from the tips of leaves that were, to the naked eye, free from soil" and that when these vegetables were grown under natural conditions (except for the artificial inoculation of the soil) the infectious material could be isolated from the leaves up to 31 days.

"Rainfall will not free the vegetables from the infected material".

15. According to Melick (13) "Morse (15) attributed 49 typhoid cases among inmates of an insane asylum to the eating of celery." Typhoid cases had occurred in the institution a few months previously, the celery bed received the institutions sewage, and the epidemic occurred soon after the first use of the celery.

16. According to Melick (13) "Picley (16) records 2 cases of typhoid from eating uncooked rhubarb, which was grown on soil known to be fertilized with typhoid bearing excreta."

17. Veatch (17a) in discussing the Denver, Colorado sewage disposal problem notes that on certain days the Denver sewage accounts for 97% of the flow of the South Platte River, which is used for irrigation immediately downstream. He refers to the construction at Denver in 1937 of a sewage treatment plant which included "fine grained rapid sand filters to secure a high rate of removal of suspended solids and incidentally the removal of ... the encysted type of amoeba (Endamoeba histolytica) which is strongly suspected of

being responsible, through the medium of sewage irrigated vegetables, for a considerable amount of sickness in this area." (Abstractor's note: The magnetite filters referred to did not operate satisfactorily and their use was discontinued.)

18. Tanner (18) points out that missed cases and carriers may always be present and that sewage should always be regarded as containing infectious organisms. The work of several investigators is cited and Tanner concludes that (18a) "Sufficient data ... have been recorded to justify the conclusion that polluted soil may infect vegetables grown on it." He adds (18b) that "good epidemiological evidence seems to exist in the literature to the effect that fresh vegetables may and have caused communicable diseases and that the sanitary condition of the soil from which they are harvested is important." - and finally (18c) that "This review of the literature quite clearly indicates that fresh vegetables which are raised on polluted soil may transmit pathogenic bacteria."

19. Rider (19) in commenting on irrigation in Arizona notes the insanitary practices of many camps of agricultural workers and the use of the main canals for drinking water, swimming, washing clothes, etc. In spite of such conditions only a few instances were noted where water borne diseases were attributed to canal water. Several years ago, as the result of a newspaper syndicated article, the state laboratory undertook bacteriological examination of lettuce. Many heads -- from 16 fields in the Salt River Valley and from two in the Eloy district -- were cultured but no evidence of typhoid or allied organisms was found. Although the technique used was rather hastily devised, it was felt any general contamination would have been indicated.

20. The Committee on Sewage Disposal, American Public Health Association (20) notes in 1937, that "California, alone, out of 33 states reporting, ... has adopted regulations under its Public Health Act whereby the disposal of sewage, sewage effluent or sludge for irrigation or fertilizing purposes" requires a permit from the State Board of Health. Briefly these California Regulations require that raw sewage shall not be used for irrigating growing crops, and settled or undisinfected sewage is banned for the irrigation of growing vegetables, garden truck, berries, or low-growing fruit, or for watering vineyards or orchards where windfalls or fruit lie on the ground.

21. The Committee on Utilization of Sewage Sludge as Fertilizer, Federation of Sewage Works Associations, in their report (21) in 1942, notes the California regulations are still in effect. Several other states regulate or advise regarding use of sewage sludge.

22. Rawn (22) notes that as of June, 1934, 39 states and the District of Columbia had replied to a questionnaire on use of sewage for irrigation. Thirty states reported neither sewage nor sewage-polluted waters were used for irrigation within their boundaries. Seventeen of these states reported they would not tolerate such use, and the other 13 found it repugnant.

"In the 9 states which admitted use of sewage for irrigation, the attitude was one of tolerance ... and rigid regulations of the production of the effluent as well as the nature of the crops for which it was to be used."

23. DeMartini (23) mentions the following regulations concerning irrigation with sewage and sewage-laden waters:

(1) Colorado - "Requires written permission of State Board of Health for use of sewage or sewage-polluted waters when Coli-aerogenes group of bacteria exceeds 10 per cc."

(2) California and Oregon - "Prohibit use of raw sewage for irrigating growing crops. Prohibit use of settled or undisinfected sewage effluents on growing vegetables and garden truck. Highly oxidized and disinfected sewage effluents can be used provided they meet drinking water standards in Oregon and in California if not over 10% of 10cc. portions are positive for the Coli-aerogenes group. Also no single sample can be positive for over half of the 0.1 cc. portions examined."

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APPENDIX "G"

REPUBLICAN RIVER COMPACT

The States of Colorado, Kansas, and Nebraska, parties signatory to this compact (hereinafter referred to as Colorado, Kansas, and Nebraska, respectively, or individually as a State, or collectively as the States), having resolved to conclude a compact with respect to the waters of the Republican River Basin, and being duly authorized therefor by the Act of the Congress of the United States of America, approved August 4, 1942, (Public Law No. 696, 77th Congress, Chapter 545, 2nd Session) and pursuant to Acts of their respective Legislatures have, through their respective Governors, appointed as their Commissioners:

M. C. Hinderlider, for Colorado
George S. Knapp, for Kansas
Wardner G. Scott, for Nebraska

who, after negotiations participated in by Glenn L. Parker, appointed by the President as the Representative of the United States of America, have agreed upon the following articles:

Article I

The major purposes of this compact are to provide for the most efficient use of the waters of the Republican River Basin (hereinafter referred to as the "Basin") for multiple purposes; to provide for an equitable division of such waters; to remove all causes, present and future, which might lead to controversies; to promote interstate comity; to recognize that the most efficient utilization of the waters within the Basin is for beneficial consumptive use; and to promote joint action by the States and the United States in the efficient use of water and the control of destructive floods.

The physical and other conditions peculiar to the Basin constitute the basis for this compact, and none of the States hereby, nor the Congress of the United States by its consent, concedes that this compact establishes any general principle or precedent with respect to any other interstate stream.

Article II

The Basin is all the area in Colorado, Kansas, and Nebraska, which is naturally drained by the Republican River, and its tributaries, to its junction with the Smoky Hill River in Kansas. The main stem of the Republican River extends from the junction near Haigler, Nebraska, of its North Fork and the Arikaree River, to its junction with Smoky Hill River near Junction City, Kansas. Frenchman Creek (River) in Nebraska is a continuation of Frenchman Creek (River) in Colorado. Red Willow Creek in Colorado is not identical with the stream having the same name in Nebraska. A map of the Basin approved by the Commissioners is attached and made a part hereof.

The term "Acre-foot", as herein used, is the quantity of water required to cover an acre to the depth of one foot and is equivalent to forty-three thousand, five hundred sixty (43,560) cubic feet.

The term "Virgin Water Supply", as herein used, is defined to be the water supply within the Basin undepleted by the activities of man.

The term "Beneficial Consumptive Use" is herein defined to be that use by which the water supply of the Basin is consumed through the activities of man, and shall include water consumed by evaporation from any reservoir, canal, ditch, or irrigated area.

Beneficial consumptive use is the basis and principle upon which the allocations of water hereinafter made are predicated.

Article III

The specific allocations in acre-feet hereinafter made to each State are derived from the computed average annual virgin water supply originating in the following designated drainage basins, or parts thereof, in the amounts shown:

North Fork of the Republican River drainage basin in Colorado, 44,700 acre-feet;
Arikaree River drainage basin, 19,610 acre-feet;
Buffalo Creek drainage basin, 7,890 acre-feet;
Rock Creek drainage basin, 11,000 acre-feet;
South Fork of the Republican River drainage basin, 57,200 acre-feet;
Frenchman Creek (River) drainage basin in Nebraska 98,500 acre-feet;
Blackwood Creek drainage basin, 6,800 acre-feet;
Driftwood Creek drainage basin, 7,300 acre-feet;
Red Willow Creek drainage basin in Nebraska, 21,900 acre-feet
Medicine Creek drainage basin, 50,800 acre-feet;
Beaver Creek drainage basin, 16,500 acre-feet;
Sappa Creek drainage basin, 21,400 acre-feet;
Prairie Dog Creek drainage basin, 27,600 acre-feet;
The North Fork of the Republican River in Nebraska and the main stem of the Republican River between the junction

of the North Fork and the Arikaree River and the lowest crossing of the river at the Nebraska-Kansas state line and the small tributaries thereof, 87,700 acre-feet.

Should the future computed virgin water supply of any source vary more than ten (10) per cent from the virgin water supply as hereinabove set forth, the allocations hereinafter made from such source shall be increased or decreased in the relative proportions that the future computed virgin water supply of such source bears to the computed virgin water supply used herein.

Article IV

There is hereby allocated for beneficial consumptive use in Colorado, annually, a total of fifty-four thousand, one hundred (54,100) acre-feet of water. This total is to be derived from the sources and in the amounts hereinafter specified and is subject to such quantities being physically available from those sources:

North Fork of the Republican River drainage basin, 10,000 acre-feet;
Arikaree River drainage basin, 15,400 acre-feet;
South Fork of the Republican River drainage basin, 25,400 acre-feet;
Beaver Creek drainage basin, 3,300 acre-feet; and
In addition, for beneficial consumptive use in Colorado, annually, the entire water supply of the Frenchman Creek (River) drainage basin in Colorado and of the Red Willow Creek drainage basin in Colorado.

There is hereby allocated for beneficial consumptive use in Kansas, annually, a total of one hundred ninety thousand, three hundred (190,300) acre-feet of water. This total is to be derived from the sources and in the amounts hereinafter specified and is subject to such quantities being physically available from those sources:

Arikaree River drainage basin, 1,000 acre-feet;
South Fork of the Republican River drainage basin, 23,000 acre-feet;
Driftwood Creek drainage basin, 500 acre-feet;
Beaver Creek drainage basin 6,400 acre-feet;
Sappa Creek drainage basin, 8,800 acre-feet;
Prairie Dog Creek drainage basin, 12,600 acre-feet;
From the main stem of the Republican River upstream from the lowest crossing of the river at the Nebraska-Kansas state line and from water supplies of upstream basins otherwise unallocated herein, 138,000 acre-feet; provided, that Kansas shall have the right to divert all

or any portion thereof at or near Guide Rock, Nebraska; and
In addition there is hereby allocated for beneficial consumptive use in Kansas, annually, the entire water supply originating in the Basin downstream from the lowest crossing of the river at the Nebraska-Kansas state line.

There is hereby allocated for beneficial consumptive use in Nebraska, annually, a total of two hundred thirty-four thousand, five hundred (234,500) acre-feet of water. This total is to be derived from the sources and in the amounts hereinafter specified and is subject to such quantities being physically available from those sources:

North Fork of the Republican River drainage basin in Colorado, 11,000 acre-feet;
Frenchman Creek (River) drainage basin in Nebraska, 52,800 acre-feet;
Rock Creek drainage basin, 4,400 acre-feet;
Arikaree River drainage basin 3,300 acre-feet;
Buffalo Creek drainage basin, 2,600 acre-feet;
South Fork of the Republican River drainage basin, 800 acre-feet;
Driftwood Creek drainage basin, 1,200 acre-feet;
Red Willow Creek drainage basin in Nebraska 4,200 acre-feet;
Medicine Creek drainage basin, 4,600 acre-feet;
Beaver Creek drainage basin 6,700 acre-feet;
Sappa Creek drainage basin, 8,800 acre-feet;
Prairie Dog Creek drainage basin, 2,100 acre-feet;
From the North Fork of the Republican River in Nebraska, the main stem of the Republican River between the junction of the North Fork and Arikaree River and the lowest crossing of the river at the Nebraska-Kansas state line, from the small tributaries thereof, and from water supplies of upstream basins otherwise unallocated herein, 132,000 acre-feet.

The use of the waters hereinabove allocated shall be subject to the laws of the State, for use in which the allocations are made.

Article V

The judgment and all provisions thereof in the case of Adelbert A. Weiland, as State Engineer of Colorado, et al. v. The Pioneer Irrigation Company, decided June 5, 1922, and reported in 259 U. S. 498, affecting the Pioneer Irrigation ditch or canal, are hereby recognized as binding upon the States; and Colorado, through its duly authorized officials, shall have the perpetual and exclusive right to control and regulate diversions of water at all times by said canal in conformity with said judgment.

The water heretofore adjudicated to said Pioneer Canal by the District Court of Colorado, in the amount of fifty (50) cubic feet per second of time is included in and is a part of the total amounts of water hereinbefore allocated for beneficial consumptive use in Colorado and Nebraska.

Article VI

The right of any person, entity, or lower State to construct, or participate in the future construction and use of any storage reservoir or diversion works in an upper State for the purpose of regulating water herein allocated for beneficial consumptive use in such lower State, shall never be denied by an upper State; provided, that such right is subject to the rights of the upper State.

Article VII

Any person, entity, or lower State shall have the right to acquire necessary property rights in an upper State by purchase, or through the exercise of the power of eminent domain, for the construction, operation and maintenance of storage reservoirs, and of appurtenant works, canals and conduits, required for the enjoyment of the privileges granted by Article VI; provided, however, that the grantees of such rights shall pay to the political sub-divisions of the State in which such works are located, each and every year during which such rights are enjoyed for such purposes, a sum of money equivalent to the average annual amount of taxes assessed against the lands and improvements during the ten years preceding the use of such lands, in reimbursement for the loss of taxes to said political sub-divisions of the State.

Article VIII

Should any facility be constructed in an upper State under the provisions of Article VI, such construction and the operation of such facility shall be subject to the laws of such upper State.

Any repairs to or replacements of such facility shall also be made in accordance with the laws of such upper State.

Article IX

It shall be the duty of the three States to administer this compact through the official in each State who is now or may hereafter be charged with the duty of administering the public water supplies, and to collect and correlate through such officials the data necessary for the proper administration of the provisions of this compact. Such officials may, by unanimous action, adopt rules and regulations consistent with the provisions of this compact.

The United States Geological Survey, or whatever federal agency may succeed to the functions and duties of that agency, insofar as this compact is concerned, shall collaborate with the officials of the States charged with the administration of this compact in the execution of the duty of such officials in the collection, correlation, and publication of water facts necessary for the proper administration of this compact.

Article X

Nothing in this compact shall be deemed:

(a) To impair or affect any rights, powers or jurisdiction of the United States or those acting by or under its authority, in, over, and to the waters of the Basin; nor to impair or affect the capacity of the United States, or those acting by or under its authority, to acquire rights in and to the use of waters of the Basin;

(b) To subject any property of the United States, its agencies or instrumentalities, to taxation by any State, or subdivision thereof, nor to create an obligation on the part of the United States, its agencies or instrumentalities, by reason of the acquisition, construction, or operation of any property or works of whatsoever kind, to make any payments to any State or political subdivision thereof, state agency, municipality, or entity whatsoever in reimbursement for the loss of taxes;

(c) To subject any property of the United States, its agencies or instrumentalities, to the laws of any State to any extent other than the extent these laws would apply without regard to this compact.

Article XI

This compact shall become operative when ratified by the Legislature of each of the States, and when consented to by the Congress of the United States by legislation providing, among other things, that:

(a) Any beneficial consumptive uses by the United States, or those acting by or under its authority, within a State, of the waters allocated by this compact, shall be made within the allocations hereinabove made for use in that State and shall be taken into account in determining the extent of use within that State.

(b) The United States, or those acting by or under its authority, in the exercise of rights or powers arising from whatever jurisdiction the United States has in, over, and to the waters of the Basin shall recognize, to the extent consistent with the best utilization of the waters for multiple purposes, that beneficial consumptive use of the waters within the Basin is of paramount importance to the development of the Basin; and no exercise of such power or right thereby that would interfere with the full beneficial consumptive use of the waters within the Basin shall be made except upon a determination, giving due consideration to the objectives of this compact and after consultation with all interested federal agencies and the state officials charged with the administration of this compact, that such exercise is in the interest of the best utilization of such waters for multiple purposes.

(c) The United States, or those acting by or under its authority, will recognize any established use, for domestic and irrigation purposes, of the waters allocated by this compact which may be impaired by the exercise of federal jurisdiction in, over, and to such waters; provided, that such use is being exercised beneficially, is valid under the laws of the appropriate State and in conformity with this compact at the time of the impairment thereof, and was validly initiated under state law prior to the initiation or authorization of the federal program or project which causes such impairment.

IN WITNESS WHEREOF, the Commissioners have signed this compact in quadruplicate original, one of which shall be deposited in the archives of the Department of State of the United States of America and shall be deemed the authoritative original, and of which a duly certified copy shall be forwarded to the Governor of each of the States.

Done in the City of Lincoln, in the State of Nebraska, on the 31st day of December, in the year of our Lord, one thousand nine hundred forty-two.

M. C. HINDERLIDER
Commissioner for Colorado

GEORGE S. KNAPP
Commissioner for Kansas

WARDNER G. SCOTT
Commissioner for Nebraska

I have participated in the negotiations leading to this proposed compact and propose to report to the Congress of the United States favorably thereon.

GLENN L. PARKER
Representative of the United States

APPENDIX "H"

SUMMARY OF INDIVIDUAL RESULTS

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KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Avg. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Missouri River, below Kansas City at Liberty, Mo. Highway 71 By-pass	M-364.3 C	Jan. 22	20,000	0	10.30	70.5	>20.0	430,000	8.1		248	41
	" L	Feb. 19	29,400	2	10.35	74.8	13.7	150,000	8.3	230	202	44
	" C	"		2	10.45	75.5		230,000				
	" R	"		2	10.50	76.0		43,000				
	" L	Mar. 24	141,400	7	9.20	75.7	5.7	9,300	8.1	3400	109	11
	" C	"		7	9.55	78.5		7,500				
	" R	"		7	9.20	75.7		9,300				
	" L	10:00 A Apr. 22	49,000	15	7.75	76.3	2.8	9,300	8.2	1400	141	17
	" C	"		15	7.95	78.3		43,000				
	" R	"		15	7.80	76.9		15,000				
	" L	10:00 A May 27	40,600	21	7.00	77.8	2.7	43,000	8.2	1700	180	23
	" C	"		21	6.90	76.8		43,000				
	" R	"		21	6.80	75.7		150,000				
	" L	10:15 A July 16	85,600	25	5.35	63.8	2.2	23,000	8.1	3800	113	12
	" C	"		25	5.35	63.8		240,000				
	" R	"		25	5.30	63.3		93,000				
	" L	10:15 A Aug. 16	78,200	25	4.95	59.1	3.2	93,000	8.2	4100	123	16
	" C	"		25	4.95	59.1		430,000				
	" R	"		25	4.70	56.2		430,000				
	" L	10:15 A Sept. 13	42,800	23	6.90	79.7	2.6	230,000	8.3	1200	154	37
	" C	"		23	7.15	82.5		93,000				
	" R	"		23	6.75	77.8		93,000				
	" L	10:30 A Oct. 18	43,900	12	9.35	86.3	2.2	93,000	8.3	1100	155	20
	" C	"		12	9.35	86.3		93,000				
	" R	"		12	9.25	85.3		230,000				
	" L	10:15 A Nov. 17	46,500	6	10.70	85.8	2.6	93,000	8.3	1500	167	22
	" C	"		6	10.50	84.2		93,000				
	" R	"		6	10.40	83.4		93,000				
Missouri River, below Kansas City, Rock Island R.R. Bridge (Truman Bridge)	M-373.0 L	12:15 P Aug. 16	78,200	25	6.20	74.0	3.2	230,000	8.3	4000	123	17
	" C	"		25	5.40	64.5		430,000				
	" R	"		25	5.35	63.8		430,000				
	" L	11:45 A Sept.13	42,800	23	6.90	79.7	2.2	93,000	8.3	1200	152	33
	" C	"		23	6.80	78.[illegible]		9,100				
	" R	"		23	6.80	78.3		43,000				
	" L	11:30 A Oct. 18	43,900	12	9.40	86.7	1.6	23,000	8.3	1100	158	19
	" C	"		12	9.30	85.8		93,000				
	" R	"		12	9.45	87.2		93,000				
	" L	11:45 A Nov. 17	46,500	6	10.80	86.5	2.4	43,000	8.3	1500	162	20
	" C	"		6	10.80	86.5		43,000				
	" R	"		6	10.65	85.4		43,000				
Missouri River, Highway 71-69 at Kansas City	M-380.0 C	Jan. 22	20,000	0	12.90	88.3	3.5	2,400	8.3	35	237	34
	" L	Feb. 19	29,300	2	11.15	80.7	9.1	43,000	8.3	230	196	42
	" C	"		2	11.15	80.7		93,000				
	" R	"		2	10.85	78.4		240,000				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Missouri River, Highway 71-69 at Kansas City	M-380.0 L	Mar. 24	141,000	7	9.40	77.2	5.8	43,000	8.1	3400	106	13
	" C	"		7	9.50	78.1		43,000				
	" R	"		7	9.20	75.7		430,000				
	" L	11:45 A Apr. 22	49,000	16	8.00	80.5	4.2	9,300	8.2	1400	141	20
	" C	"		16	7.75	77.9		9,300				
	" R	"		16	7.60	76.4		230,000				
	" L	11:30 A May 27	40,600	21	7.30	81.2	3.8	240,000	8.2	1600	178	28
	" C	"		21	7.20	80.1		93,000				
	" R	"		21	6.80	75.7		460,000				
	" L	July 16	85,600	25	5.40	64.4	2.1	43,000	8.3	3800	116	12
	" C	"		25	5.30	63.3		150,000				
	" R	"		25	5.40	64.4		93,000				
	" L	10:00 A Aug.19	68,600	25	5.60	66.7	2.8	43,000	8.2	3800	129	23
	" C	"		25	5.65	67.4		93,000				
	" R	"		25	5.40	64.4		230,000				
	" L	9:30 A Sept.20	33,800	23	7.00	80.8	2.2	43,000	8.3	800	155	22
	" C	"		23	7.05	81.2		43,000				
	" R	"		23	6.70	77.3		240,000				
	" L	10:15 A Oct. 20	43,500	10	9.70	85.5	4.0	9,300	8.3	1100	156	23
	" C	"		10.	9.75	86.0		23,000				
	" R	"		10	9.40	82.9		240,000				
	" L	10:45 A Nov. 18	44,300	6	10.60	85.0	3.2	150,000	8.3	1400	164	26
	" C	"		6	10.55	84.7		43,000				
	" R	"		6	10.45	83.8		240,000				
Missouri River, Highway 69 - 169 above Kansas City	M-387.0 C	Jan. 22	19,110	0	13.00	88.9	2.2	2,400	8.3	35	224	21
	L	Feb. 20	30,820	0	13.40	91.6	5.8	43,000	8.3	600	188	26
	C	"		0	12.75	87.2		15,000				
	R	"		0	11.10	76.0		9,300				
	L	Mar.25	89,100	7	9.65	79.4	4.7	15,000	8.3	2300	127	12
	C	"		7	9.95	81.8		4,300				
	R	"		7	9.40	77.3		43,000				
	L	9:45 A Apr.23	46,800	16	7.90	79.4	2.7	2,300	8.2	1400	139	17
	C	"		16	7.80	78.4		15,000				
	R	"		16	7.80	78.4		93,000				
	L	9:30 A May 28	35,700	21	7.25	80.6	2.4	23,000	8.2	1700	184	20
	C	"		21	7.15	79.5		93,000				
	R	"		21	7.30	81.3		43,000				
	L	11:30 A July 19	74,900	25	6.30	75.3	1.5	23,000	8.2	3200	116	15
	C	"		25	6.25	74.6		210,000				
	R	"		25	6.60	78.8		43,000				
	L	11:00 A Aug. 19	61,100	25	5.65	67.4	2.6	230,000	8.1	4200	127	13
	C	"		25	6.30	75.2		93,000				
	R	"		25	5.70	68.0		43,000				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Missouri River, Highway 69 - 169 above Kansas City	M-387.0 L	10:30 A Sept. 20	31,700	23	6.95	80.1	1.1	23,000	8.3	700	153	16
	C	"		23	7.10	81.9		4,300				
	R	"		23	7.10	81.9		23,000				
	L	11:00 A Oct. 20	42,200	10	9.80	86.5	1.8	240,000	8.3	1300	150	13
	C	"		10	9.85	86.9		43,000				
	R	"		10	9.70	85.5		23,000				
	L	9:30 A Nov. 18	42,600	6	10.60	85.0	1.8	7,500	8.3	1500	162	16
	C	"		6	10.70	85.8		23,000				
	R	"		6	10.65	85.4		43,000				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 0.34 L	10:30 A Dec. 17	1,500	1	12.50	87.8	39.8	2,400,000	7.8	45	244	175
Intercity Viaduct Kansas City	" C	1947 "		2	12.45	90.0		930,000				
	" R	"		1	12.50	87.8		2,400,000				
	" L	8:15 A Dec. 26	1,450	2	12.70	91.8	5.7	23,000	8.3	30	278	167
	" C	1947 "		2	12.75	92.1		23,000				
	" R	"		2	12.80	92.5		43,000				
	" L	9:30 A Jan. 12	1,020	3	14.00	103.9	10.2	93,000	8.3	45	246	152
	" C	"		3	14.20	105.3		43,000				
	" R	"		3	13.10	97.4		23,000				
	" L	10:15 A Jan. 19	910	0	13.90	95.0	18.9	430,000	8.3	30	273	155
	" C	"		0	13.60	94.3		93,000				
	" R	"		0	14.20	97.1		240,000				
	" L	9:45 A Feb. 5	1,000	0	11.80	80.7	12.0	430,000	-	-	-	-
	" C	"		0	11.35	77.6		93,000				
	" R	"		0	11.20	76.7		93,000				
	" L	9:30 A Feb. 25	6,150	1	11.95	84.0	15.6	43,000	8.3	1800	174	75
	" C	"		1	11.85	83.3		230,000				
	" R	"		1	11.65	80.8		430,000				
	" L	9:30 A Mar. 19	12,700	7	10.10	83.2	6.1	93,000	8.0	2300	112	21
	" C	"		7	10.20	84.0		43,000				
	" R	"		7	9.75	80.1		43,000				
	" L	9:45 A Mar. 31	10,900	8	9.25	78.0	4.8	230,000	8.0	2300	115	27
	" C	"		8	9.25	78.0		43,000				
	" R	"		8	9.30	78.4		43,000				
	" L	9:30 A Apr. 16	3,800	14	8.30	80.1	3.4	43,000	8.3	210	219	58
	" C	"		14	8.60	83.0		43,000				
	" R	"		14	8.40	81.1		230,000				
	" L	10:30 A May 3	27,300	16	4.40	44.3	5.8	93,000	8.1	8600	120	21
	" C	"		16	4.40	44.3		150,000				
	" R	"		16	4.20	42.3		230,000				
	" L	9:30 A May 26	7,500	20	5.85	63.8	6.5	230,000	8.2	1600	179	59
	" C	"		20	5.70	62.2		430,000				
	" R	"		20	5.55	60.5		230,000				
	" L	10:00 A June 14	2,750	25	6.55	78.2	7.2	75,000	8.3	120	224	73
	" C	"		25	6.35	75.8		230,000				
	" R	"		25	6.05	72.2		230,000				
	" L	10:00 A July 8	15,000	27	4.85	60.2	4.8	430,000	7.9	6200	106	17
	" C	"		27	4.95	61.3		230,000				
	" R	"		27	4.65	57.6		430,000				
	" L	9:30 A Aug. 4	16,300	24	4.10	48.1	4.7	230,000	8.0	4800	148	34
	" C	"		24	4.30	50.5		230,000				
	" R	"		24	4.70	55.2		930,000				
	" L	9:45 A Aug. 25	5,300	26	5.60	68.2	4.0	230,000	8.3	900	160	62
	" C	"		26	5.90	71.3		430,000				
	" R	"		26	5.70	69.4		430,000				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 0.34 L	9:45 A Sept.23	1,920	22	5.75	65.0	9.4	930,000	8.4	210	216	153
Intercity Viaduct Kansas City	" C	"		22	5.70	64.4		230,000				
	" R	"		22	5.40	61.0		430,000				
	" L	9:15 A Oct. 22	1,300	12	8.50	78.4	8.0	230,000	8.3	75	233	192
	" C	"		12	8.40	77.5		230,000				
	" R	"		12	8.20	75.7		230,000				
	" L	9:30 A Nov. 19	1,660	9	8.25	71.2	9.8	230,000	8.3	150	244	173
	" C	"		9	8.20	70.7		93,000				
	" R	"		9	7.95	68.6		230,000				
	" L	9:45 A Dec. 6	1,780	3	10.80	80.3	7.9	930,000	8.3	140	266	164
	" C	"		3	10.90	81.0		230,000				
	" R	"		3	11.00	81.6		150,000				
Turkey Creek	K - 3.5 Tu.C.-1.6	9:30 A Sept.24	0.5	18	9.05	94.7	1.8	4,300	8.3	40	214	21
Mill Street, Kansas City, Kansas	"	9:30 A Oct. 25	1	9	11.65	100.4	3.2	2,300	8.1	30	200	28
	"	9:45 A Nov. 22	1	1	12.95	91.0	1.2	2,300	8.3	15	263	29
	"	9:30 A Dec. 8	1.5	2	12.30	88.9	1.4	2,300	8.3	15	252	29
Kansas River	K - 5.78 L	11:45 A Dec. 17	1,500	1	13.50	94.9	3.8	4,300	8.2	30	259	167
State Highway No. 132 1st Bridge West of Kansas City	" C	1947 "		1	13.30	93.5		2,400				
	" R	"		1	13.35	93.8		2,400				
	" L	9:15 A Dec.26	1,450	2	12.85	92.8	4.3	4,300	8.3	20	279	174
	" C	1947 "		2	13.10	94.6		2,300				
	" R	"		2	13.00	94.0		4,300				
	" L	10:30 A Jan. 12	1,020	2	13.50	97.6	5.2	9,300	8.3	45	246	156
	" C	"		2	14.60	105.3		9,300				
	" R	"		2	14.70	106.1		2,300				
	" C	11:15 A Jan. 19	910	0	14.90	101.9	3.7	930	8.3	15	267	146
	" R	"		0	14.90	101.9		9,300				
	" C	10:30 A Feb.5	1,000	0	11.50	78.7	2.2	7,500	-	-	-	-
	" L	10:30 A Feb.25	6,150	1	12.40	87.1	7.6	15,000	8.3	1600	156	58
	" C	"		1	12.15	85.3		23,000				
	" R	"		1	12.30	86.4		43,000				
	" L	10:15 A Mar.19	12,700	8	10.50	88.6	4.5	43,000	8.1	4000	111	20
	" R	"		8	10.50	88.6		23,000				
	" L	10:45 A Mar.31	10,900	8	9.60	81.0	3.4	43,000	8.2	2100	116	26
	" R	"		8	9.70	81.8		21,000				
	" L	10:15 A Apr.16	3,800	14	9.10	87.8	2.0	4,300	8.4	250	221	59
	" R	"		14	9.15	88.3		4,300				
	" L	10:00 A May 5	27,300	16	7.55	75.8	5.2	21,000	8.1	3200	159	31
	" R	"		16	7.55	75.8		43,000				
	" L	10:30 A May 26	7,500	20	7.40	80.8	3.7	23,000	8.3	900	195	67
	" R	"		20	7.25	79.1		93,000				
	" R	10:45 A June 14	2,750	25	7.60	90.7	2.9	93,000	8.4	260	227	60
	" L	"		25	7.50	89.5		43,000				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 5.78 L	11:15 A July 12	7,550	25	6.70	80.0	1.8	240,000	8.2	3,200	187	13
State Highway No. 132 1st Bridge West of	" R	"		25	6.70	80.0		240,000				
Kansas City	" L	10:15 A Aug. 4	18,500	24	4.60	54.0	3.8	1,100,000	8.0	7,100	122	20
	" R	"		24	4.70	55.2		240,000				
	" L	10:30 A Aug.25	5,300	26	6.80	82.8	1.[illegible]	15,000	8.3	1,000	164	63
	" R	"		26	6.65	81.0		43,000				
	" R	10:30 A Sept.23	1,920	22	8.40	95.0	3.9	24,000	8.4	190	214	152
	" L	"		22	8.30	93.9		75,000				
	" L	10:15 A Oct.22	1,290	12	10.30	95.0	4.7	23,000	8.3	60	226	202
	" R	"		12	10.45	96.5		2,300				
	" L	10:15 A Nov.19	1,640	7	9.60	78.8	3.0	15,000	8.3	160	251	178
	" R	"		7	9.40	77.3		460,000				
	" L	10:15 A Dec. 6	1,780	3	11.90	88.4	3.0	23,000	8.3	150	267	166
	" R	"		3	11.90	88.4		23,000				
Kansas River	K - 9.55 LC	12:30 P Dec. 17	1,490	1	13.35	93.8	4.0	4,300	8.3	35	261	170
State Highway No. 132 2nd Bridge West of	" RC	1947 "		1	13.30	93.5		7,500				
Kansas City near Turner, Kansas	" LC	10:00 A Dec.26	1,440	2	12.30	89.0	4.6	2,300	8.3	25	264	178
	" RC	1947 "		2	12.60	91.0		2,300				
	" C	11:15 A Jan.12	1,010	2	14.35	103.7	4.8	4,300	8.4	40	254	157
	" C	11:40 A Jan.19	900	0	14.50	99.1	2.9	2,400	8.3	15	280	145
	" C	11:15 A Feb.5	1,020	0	11.55	79.0	2.2	2,400	-	-	-	-
	" C	11:00 A Feb.25	6,100	1	12.20	85.7	7.8	23,000	8.3	1,600	156	101
	" C	10:45 A Mar.19	13,300	9	10.15	87.7	5.1	23,000	8.2	3,500	113	21
	" L	11:15 A Mar.31	11,000	8	9.50	80.1	3.9	43,000	8.3	2,200	116	26
	" R	"		8	9.70	81.8		23,000				
	" L	11:00 A Apr.16	3,780	14	9.20	88.8	1.6	23,000	8.4	250	221	59
	" R	"		14	9.30	89.8		15,000				
	" L	11:30 A May 3	28,200	16	4.85	48.8	5.4	240,000	8.1	9,400	122	16
	" R	"		16	4.60	46.3		43,000				
	" L	11:15 A May 26	7,400	20	7.35	80.2	3.6	15,000	8.3	1,000	184	65
	" R	"		20	7.25	79.1		43,000				
	" L	11:30 A June 14	2,680	25	7.60	90.8	2.8	93,000	6.4	260	229	58
	" R	"		25	7.65	91.3		93,000				
	" L	11:00 A July 8	14,300	27	5.70	70.7	2.9	240,000	8.0	6,200	102	14
	" R	"		27	5.75	71.3		460,000				
	" L	11:15 A Aug. 4	24,000	24	5.30	62.2	3.3	93,000	8.0	5,400	124	21
	" R	"		24	5.30	62.2		240,000				
	" L	11:00 A Aug. 25	5,160	26	6.70	81.5	1.7	43,000	8.3	1,100	160	65
	" R	"		26	6.65	81.0		15,000				
	" L	9:55 A Sept.23	1,780	22	8.15	92.1	4.4	9,300	8.4	210	215	92
	" R	"		22	8.35	94.4		4,300				
	" L	11:00 A Oct. 22	1,280	12	10.15	93.7	4.9	9,300	8.3	110	231	199
	" R	"		12	10.20	94.2		9,300				
	" L	11:00 A Nov.19	1,630	7	9.70	79.7	3.0	43,000	8.3	180	249	180
	" R	"		7	9.55	77.7		4,300				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 9.55 L	10:45 A Dec. 6	1,780	3	12.05	89.5	3.3	43,000	8.3	160	269	167
State Highway No. 132 2nd Bridge West of	" R	"		3	11.90	88.4		93,000				
Kansas City near Turner, Kansas												
Mill Creek #1	K - 15.6 Mi.C.#1	10:45 A Feb. 20	2	0	11.20	90.3	3.0	4,300	8.3	130	139	8.5
Bridge at Holliday, State Highway #7	1.7 C "	9:00 A Mar. 22	30	9	10.00	86.5	0.8	9,300	8.4	130	200	10
	"	9:15 A Apr. 2	10	8	10.60	89.4	1.0	7,500	8.4	60	208	12
	"	9:00 A Apr. 19	5	16	7.85	78.8	2.3	2,300	8.3	130	200	13
	"	9:00 A May 5	10	16	7.25	72.8	1.8	2,300	8.3	320	191	10
	"	11:45 A May 28	3	19	8.85	94.7	4.6	4,300	8.0	95	196	14
	"	10:30 A June 18	27	21	5.20	57.9	5.8	240,000	7.6	800	117	11
	"	9:00 A July 12	5	24	4.35	51.0	4.5	2,300	8.0	140	129	19
	"	11:15 A Aug 5	60	21	5.85	66.2	1.5	24,000	8.0	160	152	6.0
	"	11:30 A Aug. 26	3	25	6.70	80.0	3.8	240	8.1	85	165	12
	"	10:20 A Sept 24	0.3	18	7.20	75.5	1.4	4,300	8.3	100	162	8.5
	"	10:20 Oct. 25	1	8	11.25	95.0	3.6	2,300	8.1	30	204	15
	"	10:30 A Nov. 22	1	1	10.70	75.2	2.2	4,300	8.3	35	203	18
	"	10:20 A Dec. 8	1	2	11.35	82.0	1.7	2,300	8.3	25	223	18
Kansas River	K - 20.2 L	9:45 A Dec. 18	1,490	1	13.00	91.4	4.8	4,300	8.3	35	266	150
Bridge at Bonner Springs	" C	1947 "		1	13.10	92.0		9,300				
	" R	"		1	12.95	91.0		2,300				
	" L	9:30 A Dec. 29	1,490	2	13.25	95.8	5.0	4,300	8.3	25	277	165
	" C	1947 "		2	12.95	93.5		1,500				
	" R	"		2	13.20	95.4		2,300				
	" L	12:15 P Jan. 12	1,010	2	15.10	109.0	4.9	7,500	8.3	40	250	172
	" C	"		2	14.45	104.3		46,000				
	" R	"		2	14.10	101.9		4,300				
	" C	9:15 A Jan. 21	890	0	13.95	95.4	7.4	43,000	8.1		300	155
	" L	9:15 A Feb. 6	1,030	0	11.25	77.0	2.9	24,000	8.3	15	281	155
	" L	9:15 A Mar. 4	23,200	0	11.55	79.0	5.2	9,300	8.0	7,400	82	14
	" C	"		0	11.60	79.3		23,000				
	" R	"		0	11.60	79.3		43,000				
	" L	9:45 A Mar. 22	49,300	7	8.75	71.9	3.9	15,000	8.3	7,100	83	9.0
	" C	"		7	8.80	72.3		4,300				
	" R	"		7	8.80	72.3		43,000				
	" L	10:15 A Apr. 2	7,850	9	9.85	85.0	2.9	9,300	8.3	1,400	140	31
	" C	"		9	9.75	84.1		23,000				
	" R	"		9	9.85	85.0		15,000				
	" L	10:00 A Apr. 19	3,460	16	9.05	91.0	3.7	4,300	8.5	210	224	73
	" C	"		16	9.00	90.5		4,300				
	" R	"		16	8.80	88.5		23,000				
	" L	9:30 A May 6	8,450	16	8.00	80.5	2.8	23,000	8.3	2,000	174	34
	" C	"		16	8.20	82.5		23,000				
	" R	"		16	8.20	82.5		9,300				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
Kansas River	K - 20.2 L	10:00 A June 2	3,170	22	8.70	98.6	4.8	43,000	8.1	390	240	132
Bridge at Bonner Springs	" C	"		22	8.30	94.0		23,000				
	" R	"		22	8.10	91.7		43,000				
	" L	9:15 A June 21	6,420	20	6.85	74.8	3.8	240,000	7.9	3,700	126	54
	" C	"		20	6.60	72.0		93,000				
	" R			20	6.85	74.8		460,000				
	" L	11:15 A July 12	7,400	25	6.00	71.7	2.9	240,000	8.1	3,200	122	17
	" C	"		25	6.10	72.8		150,000				
	" R	"		25	6.10	72.8		93,000				
	" R	10:45 A Aug. 5	17,400	22	6.40	72.5	3.6	43,000	8.1	3,800	116	31
	" C	"		22	6.45	73.2		150,000				
	" L	"		22	6.40	72.5		93,000				
	" L	11:00 A Aug. 26	4,610	26	6.80	82.7	1.8	93,000	8.3	1,200	163	94
	" C	"		26	6.90	84.0		93,000				
	" R	"		26	6.80	82.7		240,000				
	" R	11:00 A Sept. 24	1,900	20	9.15	99.8	5.3	4,300	8.5	150	219	138
	" C	"		20	8.90	97.2		4,300				
	" L	"		20	8.95	97.8		43,000				
	" R	11:00 A Oct. 25	1,260	11	10.90	98.5	5.6	2,300	8.3	50	220	216
	" C	"		11	10.80	97.7		2,300				
	" L	"		11	11.00	99.4		2,300				
	" R	11:30 A Nov. 22	1,400	3	12.30	91.3	3.0	23,000	8.3	120	266	142
	" C	"		3	12.60	93.5		43,000				
	" L	"		3	12.30	91.3		93,000				
	" L	11:30 A Dec. 6	1,700	3	12.30	91.4	3.4	43,000	8.3	190	267	172
	" C	"		3	12.10	89.8		93,000				
	" R	"		3	12.25	91.0		43,000				
Kill Creek	K - 29.5 Kill Cr. 0.6	8:40 A Sept. 24	0.5	18	9.50	99.6	8.4	930	8.1	140	170	27
Kansas State Highway #10, .5 mile east of DeSoto, Kans	"	8:45 A Oct. 25	0.5	6	4.15	33.2	7.2	930	7.5	80	195	37
	"	8:45 A Nov. 22	0.5	1	5.00	35.1	6.3	24,000	8.2	65	208	32
	"	11:00 A Dec. 8	0.5	2	10.50	75.9	3.9	2,300	8.3	65	210	37
Stranger Creek	K - 33.6 St.C.-0.6	10:45 A Dec. 18	22	0	12.50	85.4	1.7	430	8.2	25	206	428
Bridge, Highway #32 Linwood		1947										
	"	11:15 A Dec. 26	19	1	12.25	86.0	2.2	2,400	8.2	20	234	456
		1947										
	"	10:15 A Jan. 5	12	0	10.50	71.8	3.2	930	8.2	20	256	498
	"	9:00 A Jan. 9	17	0	12.10	82.8	2.7	2,300	8.3	35	217	213
	"	10:30 A Jan. 14	10	0	13.30	91.0	1.9	2,300	8.2	45	172	193
	"	10:00 A Jan. 21	5	0	11.45	78.4	1.5	930	8.2	15	234	246
	"	10:00 A Feb. 4	5	0	8.80	60.2	1.1	240	8.1	15	291	268
	"	11:30 A Feb. 26	95	1	12.55	88.1	2.8	4,300	8.3	280	157	175
	"	10:35 A Mar. 22	450	10	8.60	76.0	1.4	4,300	8.3	900	131	62
	"	10:30 A Apr. 5	130	11	9.00	84.9	1.2	4,300	8.3	260	250	106
	"	10:40 A Apr. 19	50	17	7.80	80.0	3.5	930	8.3	140	232	173

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Stranger Creek	K - 33.6 St.C.-0.6	11:00 A May 5	130	16	7.55	75.8	2.9	9,300	8.1	1,500	133	61
Bridge, Highway #32 Linwood	"	8:45 A June 2	25	18	6.70	70.3	3.6	4,300	8.3	180	275	271
	"	11:30 A June 18	550	20	3.40	37.1	4.8	240,000	7.6	9,400	86	336
	"	10:15 A July 14	50	25	8.80	105.0	3.2	4,300	8.3	85	176	226
	"	10:00 A Aug. 5	200	20	5.60	61.1	1.6	43,000	7.7	1,500	82	44
	"	10:15 A Aug.26	5	26	7.25	88.1	3.0	2,300	8.2	75	211	162
	"	10:30 A Sept.27	6	16	7.60	76.5	2.8	750	8.2	95	266	560
	"	10:00 A Nov. 4	30	12	3.10	28.6	3.4	9,300	8.3	160	168	1,770
	"	10:00 A Nov. 24	12	3	8.75	64.8	3.2	930	8.3	65	255	310
Tonganoxie Creek	K-33.6 St.C.-14.0	11:15 A Mar.22	75	7	10.90	89.7	1.2	15,000	8.4	450	185	6.5
Bridge 0.4 miles	To.C.-1.0	9:30 A Apr. 5	15	13	7.00	66.0	2.3	15,000	8.3	45	239	9.5
South of schoolhouse on old Highway 24.	"	11:10 A April 19	5	17	7.80	80.0	2.9	23,000	8.2	40	212	11
2½ miles east of Tonganoxie	"	12:15 P May 5	10	16	5.15	51.8	5.8	43,000	8.2	120	241	10
	"	12:30 P June 18	7	22	6.15	68.4	4.0	240,000	7.6	2,100	102	9.0
	"	9:15 A July 14	5	25	2.95	35.2	3.6	43,000	8.2	40	226	12
	"	9:00 A Aug. 5	6	20	5.10	55.6	1.5	43,000	8.0	85	212	7.0
	"	9:00 A Aug. 26	0.25	26	3.15	38.3	5.4	23,000	8.1	50	264	14
	"	9:30 A Sept.27	0.1	14	4.60	44.5	1.8	1,400	8.1	55	271	19
	"	9:00 A Nov. 4	0.6	12	1.75	16.1	5.5	2,300	8.3	100	184	13
	"	8:45 A Nov.24	0.6	2	5.95	42.9	3.5	2,300	8.3	35	288	35
Tonganoxie Creek	K-33.6 St.C.-14.0	11:30 A June 2	2	21	0.0	0.0	74.0	>11,000,000	7.6	75	291	23
Bridge - old highway 24 and 40, 1 mile east of Tonganoxie	To.C.-3.0 "	12:15 P June 18	7	21	6.30	70.1	5.6	430,000	7.6	1,000	119	8.5
	"	9:30 A July 14	5	25	1.20	14.3	7.6	430,000	8.0	20	230	14
	"	9:15 A Aug. 5	6	20	6.20	67.7	2.1	230,000	8.2	50	226	6.0
	"	9:30 A Aug. 26	0.25	26	0.30	3.6	8.1	2,400,000	7.8	60	268	14
	"	9:45 A Sept. 27	0.1	14	0.20	1.9	11.8	430,000	7.9	60	291	25
	"	9:30 A Nov. 4	0.6	12	1.25	11.5	7.6	430,000	8.3	100	190	16
	"	9:15 A Nov. 24	0.6	5	1.30	10.2	13.8	430,000	8.1	30	281	30
Stranger Creek	K-33.6 St.C.-18.3	10:30 A Mar. 4	15	0	13.30	90.9	1.9	430	8.3	400	154	100
Bridge U.S. Highway 24 and 40, 3½ miles east of Tonganoxie	"	11:45 A Mar. 22	352	9	9.50	81.9	3.7	2,300	8.3	3,000	150	75
	"	9:00 A Apr. 5	105	12	8.80	81.1	1.5	430	8.3	210	254	144
	"	11:40 A Apr. 19	40	17	7.90	81.0	2.0	430	8.3	100	234	210
	"	11:45 A May 5	116	16	7.95	79.9	3.4	15,000	8.2	1,300	150	100
	"	10:45 A June 2	21	19	7.40	79.2	3.8	230	8.3	110	243	359
	"	1:00 P June 18	517	20	5.30	57.8	4.9	240,000	7.5	7,500	70	30
	"	8:45 A July 14	42	25	6.35	75.8	1.9	930	8.3	100	221	364
	"	8:30 A Aug. 5	164	20	6.30	68.7	3.3	> 110,000	7.6	3,600	93	66
	"	8:45 A Aug. 26	5	25	5.65	67.4	2.0	4,300	8.1	85	202	336
	"	9:00 A Sept. 27	6	15	8.10	79.8	2.9	930	8.3	75	248	137
	"	8:30 A Nov. 4	22	12	2.85	26.3	7.0	110,000	8.1	650	198	208
	"	8:30 A Nov 24	10	5	9.20	68.2	1.5	2,300	8.3	30	266	1,720

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Wakarusa River	K - 40.7 W - 1.7	11:45 A Dec.18	16	1	12.75	89.5	1.1	430	8.3	30	184	33
Bridge, State Highway No. 10, Eudora		1947										
	"	10:30 A Dec.29	12	2	12.05	87.0	1.6	93	8.1	15	247	13
		1947										
	"	11:00 A Jan. 5	5	0	11.90	81.3	2.1	93	8.3	20	271	18
	"	11:00 A Jan 21	6	0	12.80	87.6	1.3	150	8.2	15	230	12
	"	11:00 A Feb. 6	5	0	12.25	83.8	1.6	930	8.2	15	288	16
	"	12:15 P Feb. 26	72	1	12.80	89.9	2.4	930	8.3	200	158	8.0
	"	11:45 A Mar.19	1,300	11	8.90	80.4	6.2	9,300	8.0	4,700	80	6
	"	11:30 A Apr. 2	95	9	10.15	87.6	1.0	230	8.4	190	228	10
	"	11:20 A Apr. 23	23	16	7.60	76.4	1.7	2,400	8.4	180	220	15
	"	11:15 A May 6	200	15	8.40	82.8	2.0	24,000	8.3	800	205	9.0
	"	11:45 A May 28	65	21	7.00	77.9	2.9	4,300	8.0	700	146	6.0
	"	10:15 A June 21	35	21	5.20	57.9	1.2	2,300	7.9	120	192	18
	"	10:45 A July 14	70	25	5.80	69.2	0.8	24,000	8.2	180	161	9.0
	"	9:15 A Aug. 9	100	24	6.45	75.7	0.9	9,300	8.2	120	208	7.0
	"	9:30 A Aug. 30	13	26	4.90	59.6	2.1	9,300	8.3	150	225	10
	"	8:40 A Sept.29	3.3	16	6.40	64.4	2.8	2,300	7.9	65	287	9.5
	"	11:00 A Nov.4	15	13	4.15	39.1	3.5	110,000	8.3	390	164	18
	"	10:30 A Nov.24	5	4	9.45	71.9	2.0	230	8.3	55	296	20
Wakarusa River	K - 40.7 W - 32.0 C	11:15 A June 21	38	21	6.65	73.9	1.6	93,000	8.1	650	180	11
Bridge 1 mile North of Clinton	"	11:30 A July 14	72	25	6.50	77.6	2.0	9,300	8.2	260	154	7.0
	"	11:30 A Aug. 9	103	24	7.65	89.8	0.6	4,300	8.3	90	240	7.0
	"	11:45 A Sept.9	49	20	7.95	86.9	0.9	4,300	8.4	55	-	-
	"	11:00 A Sept.29	3.3	16	8.15	81.9	1.0	2,300	8.3	30	248	11
	"	11:45 A Nov. 4	14	13	8.30	78.3	3.4	2,300	8.3	60	286	15
	"	11:15 A Nov.24	5	4	12.15	92.5	1.8	430	8.3	35	296	15
Kansas River	K - 41.2 LC	11:15 A Dec.18	1,350	2	12.80	92.5	4.0	23,000	8.3	30	270	154
Bridge at Eudora	" RC	1947 "		2	12.85	92.8		75,000				
	" LC	10:30 A Dec.22	1,350	2	13.10	94.7	5.2	23,000	8.3	30	278	162
	" RC	1947 "		2	12.80	92.4		9,300				
	" LC	9:45 A Dec.30	1,420	2	13.25	95.7	4.9	4,300	8.2	25	278	171
	" RC	1947 "		2	13.00	93.9		23,000				
	" C	10:15 A Jan. 8	1,200	1	14.65	102.9	5.8	43,000	8.3	20	278	135
	" LC	9:15 A Jan. 15	1,010	0	14.50	99.2	3.8	28,000	8.4	35	254	160
	" RC	"		0	14.00	95.8		9,300				
	" C	10:30 A Jan.21	940	0	14.00	95.8	3.2	9,300	8.3	20	280	155
	" L	10:00 A Feb. 9	1,080	0	11.60	79.3	3.6	110,000	8.2	20	278	149
	" L	11:30 A Mar. 1	3,100	4	10.20	77.7	5.8	93,000	8.1	10,500	92	42
	" R	"		4	10.40	79.2		23,000				
	" L	11:30 A Mar. 25	30,200	10	9.35	82.4	3.8	4,300	8.1	4,900	79	17
	" R	"		10	9.40	82.9		4,300				
	" L	8:45 A Apr. 9	5,050	13	8.90	83.9	1.6	93,000	8.3	450	186	41
	" R			13	8.80	83.0		43,000				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 41.2 L	9:00 A Apr. 26	16,700	16	6.20	62.3	6.2	75,000	8.3	7,500	158	47
Bridge at Eudora	" R	"		16	6.20	62.3		930,000				
	" L	10:45 A May 6	8,300	16	8.40	84.5	4.1	43,000	8.3	1,900	183	37
	" R	"		16	8.50	85.5		23,000				
	" L	9:00 A June 3	2,840	23	8.25	95.0	4.6	15,000	8.5	180	238	103
	" R	"		23	8.30	95.7		93,000				
	" L	9:15 A June 28	17,300	23	6.20	71.4	4.2	93,000	8.0	10,200	140	16
	" R	"		23	6.10	70.3		43,000				
	" L	9:15 A July 22	56,200	23	4.40	50.7	3.4	240,000	8.1	3,400	85	6.0
	" R	"		23	4.35	50.1		43,000				
	" L	8:45 A Aug. 9	8,400	23	7.35	34.7	2.0	43,000	8.3	2,300	136	42
	" R	"		23	7.30	84.2		43,000				
	" L	9:00 A Aug.30	3,680	27	6.65	82.5	2.0	23,000	8.4	1,000	179	72
	" R	"		27	6.60	81.8		23,000				
	" R	11:15 A Sept.27	1,720	18	10.50	110.0	3.5	15,000	8.4	120	224	110
	" L	"		18	10.40	109.2		93,000				
	" R	10:30 A Oct. 28	1,290	12	10.80	99.7	3.4	9,300	8.3	50	232	240
	" L	"		12	10.70	98.8		23,000				
	" R	9:00 A Nov. 26	1,530	5	10.70	83.7	2.5	15,000	8.3	110	263	156
	" L	"		5	10.55	82.5		93,000				
	" R	11:30 A Dec. 8	1,760	3	12.10	89.8	3.0	93,000	8.3	120	270	160
	" L	"		3	12.20	90.5		93,000				
Kansas River	K - 44.5 LC	11:15 A Dec. 22	1,350	2	12.80	92.4	4.4	7,500	8.2	25	280	165
Access road through Mr. Attenburnd's	" RC	1947 "		2	12.80	92.4		4,300				
Property	" LC	10:45 A Dec. 30	1,420	2	13.20	95.3	4.7	4,300	8.3	25	277	169
	" RC	1947 "		2	13.10	94.7		15,000				
	" R	11:00 A Jan. 8	1,200	1	14.20	99.7	5.2	23,000	8.3	20	276	135
	" R	10:15 A Jan. 15	1,020	0	14.05	96.1	3.7	9,300	8.2	35	259	156
	" R	10:45 A Jan. 26	910	0	14.50	99.1	3.9	15,000	8.3	20	291	138
	" R	10:30 A Feb. 9	1,090	0	10.85	74.3	3.2	24,000	8.4	15	280	139
	" R	9:00 A Mar. 3	3,400	3	11.50	85.3	7.2	43,000	8.1	7,700	90	15
	" R	8:45 A Mar. 26	37,000	11	8.75	78.9	5.5	23,000	7.8	4,700	86	16
	" R	9:45 A Apr. 9	5,000	14	9.00	86.8	1.2	23,000	8.3	550	184	41
	" R	9:45 A Apr. 26	16,500	16	6.40	64.3	6.1	240,000	8.3	7,500	152	43
	" R	9:15 A May 17	3,750	21	8.45	94.0	2.6	9,300	8.2	250	249	40
	" R	9:45 A June 3	2,820	23	7.85	90.5	2.4	23,000	8.3	160	233	95
	" R	10:00 A June 28	17,100	23	6.70	77.2	2.2	93,000	8.0	4,500	132	16
	" R	9:45 A Aug. 9	8,350	23	6.90	79.5	1.2	43,000	8.2	1,300	142	38
	" R	10:00 A Aug. 30	3,660	27	6.60	81.8	2.9	23,000	8.3	650	192	68
	" R	9:00 A Sept.29	2,900	17	9.40	96.7	5.2	23,000	8.3	280	228	139
	" R	10:00 A Oct. 28	1,280	12	10.40	96.0	4.5	3,900	8.3	45	228	238
	" R	9:45 A Nov. 26	1,500	5	10.70	83.7	2.4	23,000	8.3	100	263	156
	" R	9:00 A Dec. 9	1,760	2	12.10	87.4	3.5	93,000	8.3	110	271	149

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 48.2 LC	12:00 N Dec. 22	1,360	2	12.85	92.8	7.4	230,000	8.2	30	276	181
Lawrence - Access at head of 11th Street	" RC	1947 "		2	12.85	92.8		230,000				
extension	" LC	11:45 A Dec. 30	1,400	3	13.30	98.7	11.6	93,000	8.3	35	276	171
	" RC	1947 "		3	13.30	98.7		240,000				
	" R	12:15 P Jan. 8	1,200	1	14.80	104.0	8.8	430,000	8.3	15	270	139
	" R	10:45 A Jan. 15	1,030	0	13.95	95.5	7.0	93,000	8.3	30	257	156
	" R	11:30 A Jan. 26	920	0	14.10	96.5	8.6	93,000	8.3	20	286	137
	" R	11:15 A Feb. 9	1,100	0	11.95	81.8	4.6	43,000	8.5	15	285	144
	" R	10:00 A Mar. 3	3,300	3	11.85	88.0	6.1	43,000	8.1	7,700	88	14
	" R	9:15 A Mar. 26	38,000	11	8.90	80.3	5.4	43,000	7.8	5,500	92	18
	" R	10:15 A Apr. 9	4,950	14	8.55	82.5	5.4	430,000	8.3	500	180	43
	" R	10:20 A Apr. 26	16,200	16	6.50	65.3	6.3	93,000	8.3	7,500	139	35
	" R	10:00 A May 17	3,740	21	7.40	82.3	6.5	430,000	8.2	220	236	49
	" R	10:30 A June 3	2,800	23	7.85	90.5	5.7	430,000	8.3	170	228	94
	" R	10:30 A June 28	17,000	23	6.10	70.3	4.0	930,000	7.8	9,400	140	18
	" R	10:30 A July 22	50,400	23	4.70	54.2	2.4	230,000	8.0	3,400	83	7.5
	" R	10:15 A Aug. 9	8,300	23	6.90	79.5	2.7	230,000	8.2	2,300	142	49
	" R	10:45 A Aug. 30	3,620	27	6.05	75.1	7.2	93,000	8.3	800	182	81
	" R	9:45 A Sept.29	3,100	17	7.20	74.0	8.4	240,000	8.3	450	238	164
	" R	9:15 A Oct. 28	1,290	12	10.85	100.1	5.4	93,000	8.3	55	232	242
	" R	10:20 A Nov. 26	1,490	5	10.30	80.5	3.5	240,000	8.3	80	262	162
	" R	9:30 A Dec. 9	1,770	2	11.70	84.5	5.0	75,000	8.3	120	265	147
Kansas River	K - 50.15 C	12:30 P Dec. 18	1,330	2	12.30	89.0	4.8	4,300	8.3	30	272	162
Locks at Lawrence		1947										
	" C	1:00 P Dec. 22	1,370	2	12.70	91.8	3.8	15,000	8.3	25	280	178
		1947										
	" C	12:45 P Dec. 30	1,380	4	12.70	96.7	3.6	4,300	8.3	30	278	168
		1947										
	" C	11:30 A Jan. 15	1,040	1	13.75	96.7	3.3	9,300	8.2	30	255	156
	" C	12:15 P Jan. 26	930	0	13.45	92.0	3.3	4,300	8.3	20	281	136
	" C	11:45 A Feb. 9	1,110	0	11.10	76.0	2.2	4,300	8.2	20	285	146
	" C	10:30 A Mar. 3	2,900	3	11.85	88.0	7.1	2,300	8.1	7,500	90	13
	" C	9:30 A Mar. 25	38,000	11	9.15	82.6	6.2	46,000	7.8	6,700	90	17
	" C	11:00 A Apr. 9	4,900	14	8.75	84.5	1.4	23,000	8.3	550	183	45
	" C	11:00 A Apr. 26	16,000	16	5.70	57.3	5.6	240,000	8.3	7,100	141	34
	" C	10:45 A May 17	3,720	21	8.55	95.1	3.6	4,300	8.3	160	235	46
	" C	11:15 A June 3	2,780	23	7.40	85.3	2.3	23,000	8.3	180	231	86
	" C	11:00 A June 28	16,900	24	5.65	66.3	3.6	93,000	8.0	8,600	141	19
	" R	11:15 A July 22	49,500	23	5.30	61.1	3.4	230,000	8.0	3,200	81	7.0
	" R	10:30 A Aug. 9	8,250	23	6.85	78.9	2.0	230,000	8.2	2,300	142	52
	" R	11:30 A Aug. 30	3,600	27	6.65	82.5	1.1	23,000	8.4	700	180	83
	" R	10:15 A Sept 29	3,200	17	7.00	71.9	4.8	43,000	8.3	500	247	138
	" R	8:30 A Oct. 28	1,290	12	10.20	94.2	5.8	93,000	8.3	45	230	230
	" R	11:00 A Nov. 26	1,490	5	10.55	82.5	2.2	43,000	8.3	100	261	161
	" R	10:00 A Dec. 9	1,780	2	11.90	86.0	2.2	23,000	8.3	160	272	148

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 50.6 R	12:45 P Jan. 8	1,200	1	15.20	106.8	4.0	9,300	8.3	20	265	131
Lawrence water plant intake	" R	12:10 P Jan. 15	1,040	0	14.50	99.2	3.2	4,300	8.3	30	258	154
	" R	11:45 A Jan. 29	930	0	15.70	107.2	2.2	4,300	8.4	15	296	163
	" R	11:15 A Mar. 3	2,900	3	11.00	81.6	7.0	23,000	8.1	7,300	90	14
	" R	11:15 A Apr. 8	4,900	14	8.75	84.5	2.1	21,000	8.3	450	196	39
	" R	11:30 A Apr. 28	6,200	17	7.10	72.9	3.8	9,300	8.3	1,500	176	64
	" R	11:15 A May 19	2,850	21	10.00	111.2	5.4	4,300	8.5	140	209	60
	" R	11:30 A June 4	2,660	23	9.35	107.7	6.8	23,000	8.3	180	215	92
	" R	11:45 A July 1	32,510	23	5.50	63.4	3.2	240,000	7.9	5,300	103	11
	" R	11:45 A July 23	48,500	23	5.10	58.8	2.2	43,000	8.0	2,400	90	7.5
	" R	11:45 A Aug. 11	8,700	24	5.95	69.8	2.5	240,000	8.2	2,000	142	67
	" R	10:45 A Sept. 2	3,060	25	7.30	87.1	2.6	43,000	8.3	120	204	93
	" R	11:30 A Oct. 1	3,000	17	7.45	76.3	2.0	4,300	8.3	700	131	42
	" R	11:30 A Nov. 3	2,700	13	9.10	85.8	3.8	2,300	8.3	170	228	126
	" R	11:20 A Nov. 29	1,590	2	11.85	85.7	3.4	110,000	8.3	400	266	16
	" R	10:15 A Dec. 9	1,780	2	12.50	90.4	3.0	93,000	8.3	210	268	146
Kansas River												
Power Plant intake above Lawrence.	K - 54.0	12:45 P Dec. 19	1,180	2	12.45	90.0	5.0	23,000	8.2	40	277	164
		1947										
	" R	12:00 N Jan. 9	1,220	2	13.80	99.7	5.9	9,300	8.3	35	275	163
	" R	12:30 P Jan. 28	940	0	12.45	85.2	2.0	46,000	8.3	20	298	162
	"	12:05 P Feb. 16	1,840	1	10.90	76.6	2.7	43,000	8.3	35	272	138
	"	12:20 P Mar. 4	2,900	1	11.50	80.8	5.2	23,000	8.0	7,300	89	16
	" R	11:45 A Mar. 26	37,600	10	8.25	72.7	6.6	110,000	7.8	6,400	88	15
	" R	10:30 A Apr. 8	4,900	13	8.55	80.7	2.2	43,000	8.3	500	198	40
	" R	10:45 A Apr. 28	6,240	17	7.40	76.0	3.4	23,000	8.3	2,100	176	72
	" L	10:30 A May 19	2,820	21	8.65	96.3	5.4	9,300	8.4	260	246	63
	" R	10:45 A June 4	2,700	23	8.25	95.0	5.2	93,000	8.3	250	253	97
	" R	11:15 A July 1	33,300	23	5.20	59.9	3.2	93,000	8.0	5,700	100	11
	" R	11:15 A July 23	45,100	23	5.45	62.8	2.2	240,000	8.0	2,400	91	8.5
	" R	11:15 A Aug. 11	8,830	24	5.90	69.2	2.8	240,000	8.2	2,600	144	67
	" R	10:15 A Sept. 2	3,030	25	6.80	81.2	2.2	240,000	8.2	500	216	98
	" R	11:00 A Oct. 1	3,050	17	7.10	72.9	4.2	93,000	8.1	3,400	124	28
	"	11:00 A Nov. 3	2,800	13	8.00	75.5	5.0	240,000	8.3	350	213	114
	" R	10:45 A Nov. 29	1,590	2	11.95	86.3	3.0	93,000	8.3	130	276	172
	" R	10:45 A Dec. 9	1,780	2	12.30	88.9	5.2	43,000	8.3	360	270	147
Kansas River	K - 62.6 LC	11:00 A Dec. 19	1,180	2	12.30	88.9	6.4	93,000	8.3	35	281	171
Bridge at LeCompton	" RC	1947 "		2	12.25	88.5		150,000				
	" LC	12:45 P Dec. 23	1,290	3	12.60	93.5	6.4	23,000	8.3	35	282	185
	" RC	1947 "		3	12.65	94.0		93,000				
	" LC	11:30 A Dec. 29	1,350	3	13.20	97.9	5.7	23,000	8.3	45	276	166
	" RC	1947 "		3	13.20	97.9		75,000				
	" LC	12:00 N Jan. 5	1,290	1	13.15	92.5	5.2	43,000	8.3	30	286	135
	" RC	"		1	12.95	91.0		75,000				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 62.6 LC	10:45 A Jan. 9	1,220	1	14.20	99.7	7.4	230,000	8.3	40	272	185
Bridge at LeCompton	" RC	"		1	14.05	98.8		93,000				
	" LC	12:30 P Jan. 14	1,100	0	13.40	91.5	4.4	93,000	8.4	55	264	146
	" RC	"		0	13.50	92.3		43,000				
	" RC	11:30 A Jan. 28	940	0	13.05	89.3	2.4	24,000	8.3	15	296	145
	" LC	11:30 A Feb. 16	2,000	1	11.10	78.0	3.9	75,000	8.3	30	281	136
	" L	11:00 A Mar. 26	37,000	10	8.35	73.6	5.7	9,300	7.7	6,300	88	16
	" R	"		10	8.40	74.1		15,000				
	" L	9:40 A Apr. 8	4,480	13	8.20	77.4	3.0	15,000	8.3	700	199	39
	" R	"		13	8.55	80.7		43,000				
	" L	9:45 A Apr. 28	6,260	17	7.55	77.5	3.8	7,500	8.3	2,000	171	66
	" R	"		17	7.45	76.5		43,000				
	" L	9:30 A May 19	2,760	21	8.40	93.5	5.2	43,000	8.4	270	241	64
	" R	"		21	8.25	91.8		9,300				
	" L	9:30 A June 4	2,760	23	7.40	85.2	6.4	23,000	8.3	300	249	101
	" R	"		23	7.60	87.6		43,000				
	" L	10:15 A July 1	34,000	23	5.20	59.9	3.2	460,000	8.1	4,700	99	8.0
	" R	"		23	4.95	57.0		210,000				
	" L	10:00 A July 23	42,500	23	5.10	58.8	2.2	43,000	8.1	2,100	91	8.5
	" R	"		23	5.20	59.9		93,000				
	" L	10:30 A Aug. 11	8,960	24	5.25	61.6	3.4	460,000	8.2	3,600	137	53
	" R	"		24	5.30	62.2		240,000				
	" L	9:30 A Sept. 2	3,000	25	6.80	81.2	2.2	460,000	8.3	500	216	99
	" R	"		25	6.90	82.3		460,000				
	" L	10:00 A Oct. 1	2,970	17	7.55	77.6	4.4	240,000	8.3	3,600	121	31
	" R	"		17	7.75	79.6		240,000				
	" L	9:45 A Nov. 3	2,780	13	7.50	70.7	5.6	150,000	8.3	800	203	118
	" R	"		13	7.20	68.0		240,000				
	" L	10:00 A Nov. 29	1,590	2	11.75	85.0	2.8	43,000	8.3	130	274	172
	" R	"		2	11.85	85.6		93,000				
Delaware River	K- 63.3 D - 1.8 C	10:30 A Dec. 19	18	2	11.90	86.0	3.0	240	8.1	40	238	22
Bridge at Perry		1947										
	" C	12:15 P Dec. 23	33	2	12.15	87.8	3.4	2,400	8.2	20	252	25
		1947										
	" C	12:15 P Dec. 29	26	3	12.45	92.5	1.9	230	8.2	15	276	27
		1947										
	" C	12:30 P Jan. 5	12	1	12.30	86.4	1.5	430	8.3	20	286	29
	" C	10:00 A Jan. 9	10	1	14.25	100.2	1.2	150	8.2	15	277	31
	" C	11:30 A Jan. 14	10	0	13.30	91.0	3.0	4,300	8.3	60	169	14
	" C	10:45 A Jan. 29	5	0	14.00	95.8	2.6	1,500	8.4	15	324	29
	" C	11:00 A Feb. 16	10	0	11.40	78.0	3.2	750	8.1	10	276	37
	" C	11:20 A Mar. 4	155	0	12.90	88.3	1.4	4,300	8.3	300	146	9.0
	" C	10:15 A Mar 26	1,500	8	7.75	65.3	6.6	110,000	7.4	13,400	98	3.5
	" C	9:00 A Apr. 8	350	13	5.90	55.7	5.4	75,000	8.2	4,200	192	13

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Delaware River	K - 63.3 D - 1.8 C	8:45 A Apr. 28	900	16	7.85	78.9	2.8	43,000	8.2	2,600	173	8.0
Bridge at Perry	" C	8:45 A May 19	110	22	8.60	97.5	3.8	930	8.2	70	246	16
	" C	8:45 A June 4	26	23	7.45	85.8	2.6	930	8.2	55	257	21
	" C	9:30 A July 1	500	23	6.20	71.5	0.5	9,300	8.1	290	127	5.5
	" C	9:15 A July 23	400	24	5.55	65.0	1.0	46,000	8.1	390	116	6.5
	" C	9:30 A Aug. 11	280	25	6.85	81.9	0.8	930	8.3	55	239	13
	" C	9:00 A Sept. 2	28	25	6.20	74.0	1.4	230	8.2	70	259	23
	" C	9:15 A Oct. 1	36	17	7.85	80.6	1.3	4,300	8.3	65	224	21
	" C	9:15 A Nov. 3	100	13	7.20	68.0	2.4	46,000	8.3	160	203	18
	" C	9:30 A Nov. 29	30	2	11.50	83.1	1.2	430	8.3	45	264	24
Delaware River	K - 63.3 D - 24.0 C	10:15 A July 7	175	27	6.65	82.4	1.5	93,000	8.2	1,000	158	12
County Bridge 3½ miles south of	" C	10:45 A July 26	92	26	6.60	80.3	0.9	23,000	8.2	300	184	18
Valley Falls	" C	10:45 A Aug.12	150	26	6.85	83.4	0.5	9,300	8.3	100	275	18
	" C	10:15 A Sept. 9	52	20	8.20	89.7	0.6	240,000	8.3	55	233	30
	" C	11:00 A Oct. 4	9	14	8.70	84.0	0.2	2,300	8.3	50	238	32
	" C	10:45 A Nov. 8	21	7	10.15	83.5	1.1	43,000	8.3	70	229	25
	" C	10:45 A Dec. 3	17	1	12.55	88.2	0.6	15,000	8.3	15	259	29
Delaware River	K - 63.3 D - 27.7 C	9:45 A July 7	168	27	6.50	80.6	1.5	23,000	8.2	800	165	14
Road to River 1½ miles south	" C	10:30 A July 26	88	26	6.95	84.5	0.9	240,000	8.3	230	197	17
of Valley Falls	" C	10:15 A Aug. 12	140	26	7.45	90.7	1.0	4,300	8.3	100	269	18
	" R	9:45 A Sept. 9	50	20	8.85	96.8	1.2	9,300	8.3	70	236	32
	" C	10:30 A Oct. 4	9	14	11.30	109.0	0.8	15,000	8.3	20	243	26
	" C	10:15 A Nov. 8	20	7	11.50	94.7	1.7	9,300	8.3	70	232	25
	" C	10:15 A Dec. 3	16	1	14.55	102.2	1.4	4,300	8.3	15	257	31
Delaware River	K - 63.3 D - 29.7 C	9:00 A July 7	160	27	6.35	78.7	2.5	43,000	8.2	700	167	12
Bridge - Valley Falls State Highway 4 - 16	" C	9:30 A July 26	84	26	7.00	85.2	1.4	15,000	8.2	200	195	17
	" C	9:15 A Aug. 12	138	26	6.90	84.0	0.8	4,300	8.3	110	270	18
	" C	9:00 A Sept. 9	47	20	8.00	87.5	0.7	2,300	8.3	110	229	30
	" C	9:30 A Oct. 4	9	14	8.90	86.0	0.8	930	8.3	60	254	28
	" C	9:30 A Nov. 8	20	7	10.70	88.0	1.6	23,000	8.3	85	233	23
	" C	9:30 A Dec. 3	16	1	13.60	95.5	0.8	230	8.3	15	270	26
Delaware River	K - 63.3 D - 30.6 C	9:30 A July 7	160	27	6.40	79.3	4.8	23,000	8.1	1,200	170	14
County Bridge - North of Valley Falls	" C	9:45 A July 26	84	26	6.60	80.2	0.5	9,300	8.2	260	193	15
	" C	9:45 A Aug. 12	138	26	6.70	81.6	0.8	230	8.3	120	269	16
	" C	9:35 A Sept. 9	47	20	7.50	82.0	0.7	2,300	8.3	120	221	28
	" C	10:00 A Oct. 4	9	14	9.00	87.0	0.4	2,300	8.3	80	251	27
	" C	9:45 A Nov. 8	20	7	10.40	85.7	1.2	2,300	8.3	85	230	21
	" C	9:45 A Dec. 3	16	1	13.95	97.9	0.2	930	8.3	20	257	25
Elk Creek	K-63.3 D - 42.6	9:30 A Dec. 10	2	0	9.90	67.7	6.3	110,000	8.3	30	388	32
1 mile east of Highway #75, Holton	Elk Cr.10.3 "	10:20 A Dec. 16	2	0	12.50	85.5	4.4	2,400,000	8.3	15	332	23

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Elk Creek	K - 63.3 D - 42.6	9:15 A Dec. 10	2	0	12.30	84.2	1.8	9,300	8.3	20	354	25
At Holton on Highway	Elk Cr.11.6 "	10:30 A Dec. 16	2	0	13.75	94.1	1.2	4,300	8.2	15	309	22
#75												
Grasshopper Creek	K - 63.3 D - 50.0	10:45 A Dec. 10	1	0	13.70	93.8	1.6	4,300	8.3	45	240	16
Highway #9, 0.25 mile west of Highway #159	Gr.Cr.-0.8 "	9:30 A Dec. 16	1	0	11.55	79.0	2.8	9,300	8.3	35	235	18
Delaware River	K -63.3 D - 50.6	10:20 A Dec. 10	8	0	16.40	112.0	0.7	2,300	8.3	15	298	18
Highway #9, 2 miles west of Highway #159	"	9:45 A Dec. 16	10	0	13.85	94.8	1.3	1,500	8.3	25	263	18
near Muscotah												
Kansas River	K - 73.9 R	12:45 P Jan. 7	1,270	1	14.25	100.2	6.2	93,000	8.3	30	268	143
Power plant intake below Topeka	" R	12:30 P Jan. 16	1,200	0	13.90	95.0	3.8	15,000	8.3	30	278	165
	"	12:40 P Feb. 2	970	0	11.90	81.5	2.5	93,000	8.3	30	272	161
	"	11:30 A Feb. 18	1,300	2	11.60	83.8	7.1	240,000	8.3	500	184	73
	" R	11:45 A Mar. 5	13,500	0	12.30	84.0	5.5	93,000	8.1	6,200	92	19
	" R	11:20 A Mar. 29	9,200	8	10.15	65.7	3.6	9,300	8.1	2,200	104	30
	" R	11:30 A Apr. 12	3,520	12	9.50	87.6	1.9	93,000	8.4	400	210	57
	" R	11:15 A Apr. 29	4,200	17	7.80	80.0	3.8	240,000	8.3	2,000	176	71
	" R	11:30 A May 20	2,550	22	8.30	94	4.8	43,000	8.3	210	203	75
	" R	11:45 A June 7	2,740	24	6.50	76.2	3.2	43,000	8.1	1,400	198	55
	" R	11:30 A July 2	28,000	23	5.45	62.8	3.5	93,000	7.9	5,700	110	9.0
	" R	11:45 A July 29	19,000	26	5.80	70.6	2.4	93,000	8.1	1,000	127	14
	" R	12:15 P Aug. 13	6,000	25	5.85	69.8	2.8	240,000	8.2	650	166	61
	" R	11:45 A Sept. 8	2,600	20	7.20	78.8	3.4	460,000	8.3	400	201	104
	" R	11:45 A Oct. 7	1,740	12	8.80	81.2	4.4	460,000	8.3	600	214	69
	" R	11:30 A Nov. 15	1,740	7	10.35	85.2	3.5	43,000	8.3	280	245	185
	" R	11:30 A Nov. 30	1,630	2	11.80	85.3	3.0	93,000	8.3	130	284	180
	" R	11:40 A Dec. 13	1,590	2	12.45	90.0	3.6	15,000	8.3	330	267	159
Kansas River	K - 76.2 R	12:15 P Jan. 7	1,270	2	14.30	103.2	5.8	23,000	8.3	25	274	139
Northeast Topeka Airport. Access road	" R	12:10 P Jan. 16	1,190	0	13.50	92.3	3.9	43,000	8.3	30	286	165
to Mr. Childs' Farm.	" R	12:15 P Feb. 2	1,030	0	11.60	79.3	2.2	21,000	8.3	25	274	159
	" R	10:45 A Feb. 18	1,290	1	11.30	79.4	6.8	93,000	8.3	600	204	88
	" R	11:30 A Mar. 5	13,500	0	12.40	84.8	5.7	43,000	8.1	6,500	88	20
	" R	11:00 A Mar. 29	9,120	8	9.90	83.5	4.0	9,300	8.1	2,100	101	25
	" R	11:00 A Apr. 12	3,510	12	9.30	85.8	2.1	43,000	8.4	400	208	57
	" R	10:45 A Apr. 29	4,100	17	7.70	79.0	3.7	43,000	8.4	1,800	174	73
	" R	11:00 A May 20	2,500	22	8.60	97.4	4.2	43,000	8.3	230	200	74
	" R	11:15 A June 7	2,750	24	6.85	80.4	3.1	43,000	8.1	1,300	200	56
	" R	10:45 A July 2	27,500	23	5.65	65.1	3.5	240,000	7.9	5,800	103	8.5
	" R	11:30 A July 29	17,500	26	5.70	69.5	2.3	23,000	8.1	1,000	129	14
	" R	11:30 A Aug. 13	5,800	25	5.95	71.0	4.0	1,100,000	8.3	900	172	64
	" R	11:15 A Sept. 8	2,650	20	7.65	83.7	2.8	240,000	8.4	380	215	106
	" R	11:15 A Oct. 7	1,740	12	7.40	68.3	2.8	93,000	8.1	120	262	36
	" R	11:00 A Nov. 15	1,740	7	10.30	84.9	3.4	210,000	8.3	400	254	184
	" R	11:00 A Nov. 30	1,630	2	12.60	91.0	4.5	23,000	8.3	100	280	175
	" R	11:20 A Dec. 13	1,590	2	12.40	89.5	3.4	23,000	8.3	340	262	160

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 78.7 R	9:45 A Jan. 7	1,270	1	14.70	103.0	8.5	230,000	8.3	30	276	143
A.T. & S.F. RR paralleling old Hwy.	" L	10:30 A Jan 16	1,180	0	13.80	94.4	3.6	230,000	8.2	30	286	170
# 24, east of Topeka.	" L	10:45 A Feb. 2	1,050	0	11.30	77.3	2.4	43,000	8.3	25	277	162
	" L	9:30 A Feb. 18	1,290	0	11.10	76.0	5.2	15,000	8.3	800	206	85
	" L	9:15 A Mar. 5	13,500	1	12.20	85.8	5.8	15,000	8.3	5,800	95	19
	" L	9:15 A Mar. 29	9,100	7	10.00	82.3	3.5	15,000	7.9	2,400	104	25
	" L	9:15 A Apr. 12	3,500	12	9.30	85.8	1.6	15,000	8.4	400	206	58
	" L	9:15 A Apr. 29	4,000	17	7.80	80.0	3.2	15,000	8.4	1,800	173	70
	" L	9:00 A May 20	2,450	21	7.40	82.4	4.8	75,000	8.3	230	203	72
	" L	9:00 A June 7	2,760	24	6.70	78.5	3.2	9,300	8.1	1,200	194	57
	" L	8:45 A July 2	27,000	23	5.75	66.3	3.1	23,000	8.0	5,700	103	8.0
	" L	9:00 A July 29	16,000	26	5.70	69.5	1.4	21,000	8.1	1,000	126	12
	" L	9:00 A Aug. 13	5,600	26	6.50	79.2	1.8	240,000	8.3	900	168	66
	" L	9:15 A Sept. 8	2,700	20	7.45	81.3	2.3	240,000	8.4	390	214	112
	" L	9:30 A Oct. 7	1,740	12	9.10	83.9	3.9	43,000	8.3	340	224	59
	"	9:00 A Nov. 15	1,740	7	10.50	86.4	4.8	93,000	8.3	260	242	188
	"	9:15 A Nov. 30	1,620	2	11.75	84.9	3.4	75,000	8.3	120	280	181
	"	9:45 A Dec. 13	1,590	2	12.05	87.0	5.1	9,300	8.3	330	263	157
Soldier Creek	K - 80.2 SC - 2.3 C	10:30 A Jan. 7	2	7	11.85	97.5	5.0	110,000	8.3	30	300	41
Bridge above North Topeka	" C	11:00 A Jan. 16	2	3	13.20	98.0	3.6	150,000	8.3	30	296	28
	" C	11:15 A Feb. 2	2	6	13.75	110.2	2.1	9,300	8.2	20	284	23
	" C	9:45 A Feb. 18	480	1	11.40	80.0	6.4	4,300	8.2	2,000	106	9.0
	" C	9:45 A Mar. 5	19	3	12.80	95.0	2.9	4,300	8.3	1,200	176	11
	" C	9:40 A Mar. 29	48	8	10.75	90.7	2.1	9,300	8.3	450	209	12
	" C	9:30 A Apr. 12	25	12	9.95	91.8	3.4	93,000	8.4	60	224	18
	" C	9:30 A Apr. 29	47	16	8.60	86.5	2.1	15,000	8.3	450	197	10
	" C	9:15 A May 20	25	21	9.50	105.7	3.6	4,300	8.2	45	246	39
	" C	9:30 A June 7	12	24	11.15	130.9	2.6	4,300	8.1	23	256	21
	" C	9:00 A July 2	55	22	6.80	77.0	0.9	2,300	8.3	200	194	14
	" C	9:30 A July 29	16	27	6.05	75.0	1.0	9,300	8.3	140	240	16
	" C	10:00 A Aug. 13	35	24	6.30	74.0	3.6	93,000	8.1	1,000	136	7.0
	" C	9:30 A Sept. 8	9	20	7.75	84.8	3.4	93,000	8.2	110	212	23
	" C	9:45 A Oct. 7	4	12	9.40	86.7	4.1	2,300	8.3	30	271	20
	" C	9:15 A Nov. 15	4	9	10.55	91.0	4.4	15,000	8.3	30	293	18
	" C	9:30 A Nov. 30	6	4	11.40	86.8	2.5	23,000	8.3	20	303	25
	" C	10:00 A Dec. 13	3	4	12.90	98.3	2.7	15,000	8.3	15	289	28
Kansas River	K - 81.0 C	10:30 A May 20	2,400	22	8.45	95.7	4.2	43,000	8.3	230	206	74
Bridge - East of North Topeka	" L	10:30 A June 7	2,770	24	6.85	80.3	4.3	93,000	8.1	1,400	188	58
	" R	"		24	6.70	78.5		240,000				
	" R	10:15 A July 2	26,700	23	5.70	65.8	3.5	93,000	8.1	5,600	106	9.5
	" L	"		23	5.80	66.8		43,000				
	" L	11:00 A July 29	15,000	26	6.05	73.8	2.6	. 23,000	8.2	1,000	130	13
	" R	"		26	5.70	69.5		240,000				

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 81.0 L	11:00 A Aug. 13	5,420	25	6.80	81.2	2.3	43,000	8.3	1,000	172	68
Bridge - East of North Topeka	" R	"		25	6.50	77.6		1,100,000				
(Sardou Ave.)	" R	10:45 A Sept. 8	2,700	20	7.85	85.8	2.9	240,000	8.5	450	218	119
	" L	"		20	8.10	88.6		23,000				
	" L	10:45 A Oct. 7	1,750	12	9.85	90.8	3.2	93,000	8.4	340	216	42
	" R	"		12	9.70	89.5		93,000				
	" L	10:30 A Nov. 15	1,750	7	10.80	88.8	5.0	93,000	8.3	280	243	189
	" R	"		7	10.70	88.1		240,000				
	" L	10:30 A Nov. 30	1,610	2	12.30	88.9	4.0	9,300	8.3	210	279	187
	" R	"		2	12.20	88.2		93,000				
	" L	11:00 A Dec. 13	1,585	2	12.35	89.2	4.2	43,000	8.3	370	255	154
	" R	"		2	12.10	87.5		93,000				
Kansas River	K - 85.5 L	11:45 A Jan. 7	1,280	1	15.90	111.8	4.9	430	8.3	35	272	148
U.S. Highway No. 40 Bridge west of	" C	11:30 A Jan. 16	1,150	0	14.25	97.5	1.9	750	8.2	30	276	157
Topeka	" LC	11:30 A Feb. 2	1,110	0	11.10	76.0	1.2	4,300	8.2	25	271	161
	" LC	10:15 A Feb. 18	1,270	1	11.90	83.6	3.8	4,300	8.3	450	207	91
	" L	10:30 A Mar. 5	13,400	0	12.35	86.5	5.8	9,300	8.3	6,000	92	18
	" R	"		0	12.20	83.5		4,300				
	" L	10:15 A Mar 29	9,040	8	10.30	87.0	4.0	9,300	8.2	2,200	101	27
	" R	"		8	10.10	85.2		7,500				
	" L	10:15 A Apr. 12	3,450	12	9.50	87.7	1.9	4,300	8.4	390	208	58
	" R	"		11	9.40	84.9		9,300				
	" L	10:00 A Apr. 29	1,830	17	8.00	82.3	3.5	93,000	8.4	1,600	179	69
	" R	"		17	8.00	82.3		9,300				
	" L	10:00 A May 20	2,350	22	8.70	98.6	4.1	4,300	8.4	230	207	74
	" R	"		22	8.45	95.8		4,300				
	" L	10:00 A June 7	2,790	24	6.85	80.3	3.6	15,000	8.1	1,300	200	63
	" R	"		24	6.80	79.7		23,000				
	" L	9:45 A July 2	26,710	23	5.85	67.4	3.6	93,000	8.0	5,700	105	9.0
	" R	"		23	5.80	66.8		43,000				
	" L	10:00 A July 29	14,310	26	6.10	74.3	1.6	43,000	8.2	1,000	128	13
	" R	"		26	5.85	71.2		43,000				
	" L	10:30 A Aug. 13	5,420	25	6.80	81.2	1.2	23,000	8.3	1,000	168	69
	" R	"		25	6.80	81.2		43,000				
	" L	10:00 A Sept. 8	2,710	20	8.10	88.6	1.8	9,300	8.4	450	230	125
	" R	"		20	7.95	86.9		7,500				
	" L	10:15 A Oct. 7	1,750	12	9.75	90.0	1.6	23,000	8.4	310	216	38
	" R	"		12	9.60	88.6		4,300				
	" L	9:45 A Nov. 15	1,750	7	10.85	89.3	2.5	15,000	8.3	280	243	188
	" R	"		7	10.65	87.7		4,300				
	" L	10:00 A Nov. 30	1,600	2	12.20	88.2	2.4	9,300	8.3	160	282	186
	" R	"		2	12.30	88.9		9,300				
	" L	10:15 A Dec. 13	1,580	2	12.20	88.1	3.0	4,300	8.3	360	260	156
	" R	"		2	11.80	85.3		4,300				

KANSAS RIVER POLLUTION INVESTIGATION
LAPORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Mill Creek #2	K - 101.5 M.C.#2-2.5 C	10:30 A Apr. 7	30	16	8.25	82.9	2.0	930	8.3	290	214	9.0
Bridge above	" C	10:30 A Apr. 21	25	17	8.60	88.3	2.7	430	8.3	220	214	15
confluence with Kansas River	" C	10:30 A May 7	100	15	8.85	87.2	1.1	2,300	8.3	120	231	9.0
	" C	10:30 A June 16	500	25	5.40	64.5	4.0	4,300	8.1	140	205	14
	" C	10:00 A July 21	500	23	5.00	57.6	2.2	>110,000	8.2	2,300	88	4.0
	" C	10:30 A Aug. 18	35	26	7.10	86.4	0.8	9,300	8.3	70	227	17
	" C	10:15 A Sept.10	20	21	8.35	92.9	1.6	4,300	8.3	80	228	19
	" C	10:30 A Oct. 6	1	14	8.70	84.0	2.2	4,300	8.3	70	231	16
	" C	10:15 A Nov. 10	10	4	10.60	80.8	3.6	930	8.3	30	257	27
	" C	10:45 A Dec. 17	9	0	12.30	84.1	3.5	930	7.9	15	270	29
Kansas River	K - 108.9 C	11:00 A Mar 10	4,720	0	12.60	86.2	5.4	21,000	8.3	2,000	117	27
Bridge - State Highway No. 63 -	" C	10:40 A Mar.17	5,620	3	11.50	85.5	5.3	9,300	8.0	2,400	125	31
South of St. Marys	" C	10:00 A Apr. 7	3,480	15	8.70	85.8	2.0	4,300	8.3	500	188	44
	" C	9:50 A Apr. 21	2,110	16	9.15	92.0	4.4	4,300	8.4	200	229	93
	" C	9:45 A May 7	6,320	14	8.00	77.2	4.4	15,000	8.1	3,000	146	36
	" C	10:00 A June 16	1,850	22	4.95	56.1	4.4	460,000	7.8	3,600	155	38
	" C	9: 15 A July 21	60,000	22	4.50	51.0	2.0	93,000	8.3	2,500	82	7.0
	" C	9:45 A Aug. 18	7,920	25	6.45	77.0	2.1	93,000	8.1	2,300	129	49
	" C	9:35 A Sept.10	1,980	19	7.50	80.1	2.2	23,000	8.3	1,000	214	113
	" C	9:45 A Oct. 6	1,600	15	8.75	86.2	1.6	43,000	8.3	260	216	41
	" C	9:40 A Nov. 10	2,180	5	10.90	85.3	3.6	23,000	8.3	450	215	92
	" C	10:00 A Dec. 17	1,450	1	13.20	92.8	2.9	12,000	8.3	230	268	183
Vermillion River	K 116.9 V - 1.3 C	10:15 A Mar. 10	10	0	12.80	87.6	1.6	430	8.4	290	226	11
Bridge - U.S. Highways Nos. 24 & 40	" C	10:10 A Mar. 17	300	2	11.75	85.0	4.5	4,300	7.9	3,100	91	4.0
	" C	9:30 A Apr. 7	30	15	8.70	85.8	2.1	430	8.3	230	264	10
	" C	9:15 A Apr. 21	20	17	9.05	93.0	4.0	930	8.2	110	243	13
	" C	9:15 A May 7	100	14	8.75	84.5	1.1	9,300	8.3	220	247	7.5
	" C	9:30 A June 16	500	21	3.00	33.4	4.8	430,000	7.5	9,400	130	5.5
	" C	8:45 A July 21	1,000	23	4.80	55.3	3.0	93,000	8.2	1,600	93	6.5
	" C	9:15 A Aug. 18	40	24	6.20	72.8	1.2	15,000	8.2	240	199	25
	" C	9:00 A Sept.10	20	18	7.45	78.1	0.9	9,300	8.3	95	246	9.0
	" C	9:15 A Oct. 6	20	15	7.40	73.0	3.2	2,300	8.3	75	309	11
	" C	9:15 A Nov.10	50	4	9.50	72.3	2.6	2,300	8.3	70	286	14
	" C	9:30 A Dec.17	35	0	13.50	92.4	2.4	430	8.1	20	286	18
Vermillion River	K - 116.9 V - 34.0 C	5:30 A June 30	80	21	7.20	80.2	1.2	15,000	8.2	340	167	6.0
County Bridge - 2 miles south of	" C	6:15 A July 30	55	27	6.65	82.5	0.6	43,000	8.4	120	247	5.0
Onaga	" C	6:15 A Aug. 27	19	24	6.20	72.6	0.3	4,300	8.2	40	266	8.5
	" C	7:00 A Sept.22	14	22	5.80	65.7	1.0	2,300	8.3	45	255	5.0
	" C	6:00 A Oct. 29	12	11	9.60	86.7	3.8	2,300	8.1	25	340	9.0
	" C	7:15 A Dec. 7	16	0	12.90	88.3	1.8	9,300	8.2	20	306	9.0

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Vermillion River	K - 116.9 V - 35.3 C	5:15 A June 30	64	21	7.20	80.2	1.6	43,000	8.2	310	162	6.5
County bridge under	" C	6:00 A July 30	51	27	6.66	82.5	1.4	93,000	8.3	110	290	5.5
construction - 1 mile south of Osage	" C	6:00 A Aug. 27	16	24	6.30	73.8	1.1	23,000	8.2	40	260	9.5
	" C	6:30 A Sept.22	13	22	6.40	72.5	1.6	2,300	8.3	45	251	6.0
	" C	6:30 A Oct. 29	12	11	8.95	80.8	1.6	930	8.1	45	347	9.0
	" C	6:45 A Dec. 7	15	0	13.30	91.0	0.9	9,300	8.3	15	300	10
Vermillion River	K - 116.9 V - 36.3 C	5:00 A June 30	64	21	7.00	77.9	1.0	15,000	8.3	700	166	5.5
Bridge - State	" C	5:30 A July 30	51	27	6.60	81.8	0.9	21,000	8.3	160	254	5.0
Highway 16 - East of Osage	" C	5:45 A Aug. 27	16	24	5.90	69.2	0.8	2,300	8.3	40	261	7.0
	" C	6:05 A Sept.22	13	22	5.40	61.1	1.2	2,300	8.3	65	252	5.0
	" C	6:45 A Oct. 29	12	11	8.75	79.0	1.6	4,300	8.1	45	346	9.0
	" C	6:30 A Dec. 7	15	0	13.80	94.5	0.5	230	8.3	20	300	10
Kansas River	K - 123.6 C	9:45 A Mar. 10	4,010	0	12.80	87.6	3.9	7,500	8.2	1,300	111	27
Bridge - State	" C	9:45 A Mar. 17	5,760	3	11.30	83.9	5.6	7,500	8.1	1,800	144	42
Highway No. 99 Wamego	" C	9:15 A Apr. 7	3,280	15	8.60	84.8	3.2	15,000	8.2	450	189	47
	" C	9:00 A Apr. 21	1,980	16	8.80	88.5	5.5	43,000	8.4	190	226	100
	" C	9:00 A May 7	4,120	14	7.80	75.3	4.4	43,000	8.1	2,900	146	38
	" C	9:15 A June 16	2,110	24	6.40	75.0	3.9	240,000	8.1	1,100	170	63
	" C	8:15 A July 21	62,100	22	4.40	49.8	2.6	150,000	8.3	2,100	79	6.5
	" C	8:30 A Aug. 18	8,220	25	6.35	75.8	1.9	43,000	8.1	2,200	119	38
	" C	8:30 A Sept.10	6,320	19	7.10	76.0	3.3	240,000	8.3	2,100	174	69
	" C	8:45 A Oct. 6	1,560	15	8.55	84.2	2.4	93,000	8.3	250	224	39
	" C	8:45 A Nov.10	2,300	5	11.00	86.0	3.2	93,000	8.3	500	212	87
	" C	9:00 A Dec. 17	1,440	1	13.00	91.4	3.0	43,000	8.3	200	272	184
Kansas River	K - 132.2 C	9:10 A Mar. 10	4,010	0	12.50	85.6	5.0	43,000	8.1	2,100	121	30
Bridge - State	" C	9:15 A Mar. 17	5,480	3	11.30	83.9	4.7	9,300	8.1	1,800	140	48
Highway No. 29 - St. George	" C	8:45 A Apr. 7	3,280	14	8.70	84.0	4.4	9,300	8.2	450	191	49
	" C	8:30 A Apr. 21	1,980	16	8.90	89.5	6.7	9,300	8.3	200	224	102
	" C	8:30 A May 7	4,470	14	8.15	78.7	4.6	43,000	8.1	2,700	143	42
	" C	8:30 A June 16	2,250	24	6.35	74.5	3.2	93,000	8.1	760	193	67
	" C	7:45 A July 21	58,500	22	4.35	49.3	3.3	93,000	8.3	2,400	76	7.0
	" C	8:15 A Aug.18	7,920	25	6.40	76.4	1.9	93,000	8.1	2,200	117	37
	" C	8:00 A Sept.10	6,600	19	6.75	72.2	4.2	460,000	8.1	2,900	129	60
	" C	8:00 A Oct. 6	1,400	15	8.30	81.9	2.5	240,000	8.3	250	224	75
	" C	8:20 A Nov. 10	2,000	5	10.70	83.7	3.4	93,000	8.3	500	208	101
	" C	8:40 A Dec. 17	1,380	1	13.20	92.8	2.8	43,000	8.3	220	270	187
Kansas River	K - 140.0 R	7:45 A Mar. 17	7,040	3	11.50	85.4	4.2	15,000	8.2	1,400	155	79
Access Road 2½ mi.	" R	7:20 A Apr. 7	3,180	14	8.85	85.4	1.9	4,300	8.3	450	197	55
east of Manhattan off Highway No. 29	" R	7:15 A Apr. 21	1,980	15	8.30	81.8	4.7	4,300	8.3	220	236	120
at Farm of Mr. Coffey	" R	7:15 A May 7	3,800	14	8.20	79.1	4.1	4,300	8.1	2,700	140	46
	" R	7:15 A June 16	2,250	24	6.35	74.5	3.8	460,000	8.2	800	189	75

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Milage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Kansas River	K - 140.0 R	6:30 A July 21	55,200	22	3.60	40.8	2.2	240,000	8.3	1,800	76	7.5
Access Road 2½ mi.	" R	6:45 A Aug. 18	7,900	25	6.15	73.4	1.9	93,000	8.1	1,900	154	67
east of Manhattan off Highway No. 29	" R	6:45 A Sept. 10	6,600	20	7.25	79.2	2.9	240,000	8.3	1,600	195	152
at Farm of Mr. Coffer	" C	6:30 A Oct. 6	1,300	15	8.60	84.8	2.8	43,000	8.3	260	230	48
	" R	7:00 A Nov. 10	1,900	5	10.50	82.0	4.4	93,000	8.3	650	204	147
	" R	7:45 A Dec. 17	[illegible]	1	11.70	82.2	1.5	75,000	8.3	280	290	273
Kansas River	K - 142.7 L	7:00 A July 21	53,000	22	2.40	27.2	2.8	43,000	8.2	1,200	92	6.5
No bridge - about	" L	7:30 A Aug. 18	7,900	25	6.15	73.5	2.0	93,000	8.1	1,600	161	70
1 mile east of Manhattan	" L	7:15 A Sept. 10	6,500	19	7.50	80.1	2.3	93,000	8.3	550	251	234
	" C	7:15 A Oct. 6	750	15	8.60	84.8	1.9	15,000	8.3	230	244	39
	" C	7:45 A Nov. 10	1,000	5	10.40	81.3	5.8	240,000	8.3	400	202	169
	" L	8:00 A Dec. 17	930	1	12.60	88.5	2.2	93,000	8.3	270	281	268
Kansas River	K - 144.1 C	8:00 A Mar. 10	1,800	0	13.20	90.4	3.1	9,300	8.3	1,000	178	58
Bridge at Manhattan	" C	8:15 A Mar. 17	3,000	3	11.30	83.9	4.9	23,000	8.3	1,400	165	99
	" C	7:45 A Apr. 7	1,830	14	8.70	83.9	1.8	9,300	8.3	500	208	73
	" C	7:30 A Apr. 21	1,200	15	8.55	84.2	2.0	2,300	8.4	290	247	157
	" C	7:45 A May 7	3,000	14	8.15	78.7	4.8	21,000	8.1	2,900	125	53
	" C	7:40 A June 16	1,300	24	6.80	79.7	2.9	240,000	8.2	800	182	108
	" C	6:45 A July 21	40,000	22	4.50	51.0	2.0	93,000	8.3	1,700	73	5.5
	" C	7:15 A Aug. 18	2,900	25	6.25	74.6	2.1	240,000	8.2	1,700	159	70
	" C	7:00 A Sept.10	1,200	19	7.85	83.9	1.5	43,000	8.3	660	256	236
	" C	7:00 A Oct. 16	700	15	8.70	85.8	2.2	43,000	8.3	230	246	60
	" C	7:15 A Nov. 10	1,000	5	10.60	82.8	3.5	240,000	8.3	400	202	174
	" C	7:30 A Dec.17	930	1	11.95	83.9	1.8	15,000	8.3	280	286	274
Kansas River	K - 150.38 L	7:30 A Mar. 10	1,800	0	13.00	89.0	2.8	9,300	8.3	1,000	174	66
County Bridge - 3 mi. southeast of	" C	7:15 A Mar. 17	3,000	3	11.30	83.9	4.6	43,000	8.2	1,500	162	97
Manhattan	" C	6:45 A Apr. 7	1,830	14	8.50	82.0	2.0	4,300	8.3	500	209	74
	" C	6:45 A Apr. 21	1,200	15	8.20	80.8	3.8	43,000	8.4	290	245	160
	" C	6:45 A May 7	3,000	14	7.85	75.8	4.7	43,000	8.0	2,900	134	57
	" C	6:45 A June 16	1,300	24	6.60	77.4	3.5	460,000	8.2	700	184	114
	" C	6:00 A July 21	40,000	22	4.20	47.6	2.7	39,000	8.3	1,800	73	6.5
	" C	6:00 A Aug. 18	2,910	25	6.20	74.0	3.0	240,000	8.2	1,600	156	70
	" C	6:00 A Sept.10	1,200	19	7.60	81.2	1.8	93,000	8.3	650	256	245
	" C	6:00 A Oct. 6	670	15	8.40	82.8	2.6	43,000	8.3	230	240	66
	" C	6:30 A Nov. 10	980	5	10.40	81.3	4.0	240,000	8.3	400	203	183
	" C	7:00 A Dec. 17	930	1	12.25	86.0	1.8	7,500	8.3	310	286	295
Kansas River	K - 158.9 C	9:45 A Mar. 8	1,700	0	12.60	86.1	2.4	43,000	8.1	1,700	159	48
Bridge at Ogden	" C	10:00 A Mar. 15	2,630	1	10.60	74.5	6.6	43,000	8.3	2,100	183	60
	" C	9:30 A Apr. 1	2,560	8	9.80	82.7	2.1	15,000	8.3	1,000	166	56
	" C	9:20 A Apr. 14	1,390	11	9.25	83.5	2.8	9,300	8.3	380	250	124
	" C	9:40 A Apr. 30	1,390	17	7.90	81.2	2.6	15,000	8.4	450	240	128

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
Kansas River	K - 158.9 C	9:45 A May 21	1,060	22	8.10	91.7	4.6	4,300	8.1	160	238	146
Bridge at Ogden	" C	10:00 A July 9	5,130	26	6.30	76.6	1.7	43,000	8.2	3,600	132	19
	" C	9:30 A Aug. 6	3,730	21	7.00	77.9	2.8	43,000	8.2	3,400	202	101
	" C	9:00 A Sept. 3	1,500	23	6.95	80.2	1.3	240,000	8.3	300	240	168
	" C	9:00 A Sept. 30	990	15	7.90	78.0	3.2	240,000	8.3	1,600	170	72
	" C	9:30 A Nov. 5	1,600	11	8.05	72.7	4.6	93,000	8.3	900	197	205
	" C	9:30 A Dec. 14	930	3	12.00	89.0	2.7	43,000	8.3	400	279	275
Kansas River	K - 166.8 C	9:20 A Mar. 8	1,700	0	12.55	85.8	2.4	15,000	8.2	1,700	157	64
Bridge at Marshall Field,	" C	9:15 A Mar. 15	2,630	1	12.50	87.8	2.7	9,300	8.3	550	193	57
Fort Riley	" C	9:00 A Apr. 1	2,500	8	10.10	85.3	2.2	9,300	8.3	900	178	44
	" C	8:45 A Apr. 14	1,390	11	9.50	85.8	2.4	15,000	8.4	450	249	72
	" C	9:00 A Apr. 30	1,390	17	8.10	83.2	2.7	23,000	8.4	370	251	74
	" C	9:15 A May 21	1,060	22	8.00	90.7	5.4	23,000	8.1	160	233	111
	" C	9:15 A July 9	4,960	26	6.55	79.7	2.0	43,000	8.2	3,200	129	17
	" C	8:30 A Aug. 6	3,730	21	6.95	77.4	2.6	43,000	8.2	3,300	197	108
	" C	8:15 A Sept. 3	1,500	23	6.80	78.3	1.3	93,000	8.2	300	244	181
	" C	8:45 A Sept. 30	990	15	8.10	80.0	3.0	43,000	8.3	1,000	204	67
	" C	9:00 A Nov. 5	1,500	11	8.45	76.3	4.6	43,000	8.3	900	198	205
	" C	9:10 A Dec. 14	890	3	12.25	91.0	2.6	43,000	8.3	400	279	272

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Big Blue River Bridge - U. S. Highway No. 40 & 24	B - 0.44 C	8:30 A Mar. 10	2,700	0	12.80	87.6	4.8	2,300	8.0	2,300	76	9.5
	•	8:45 A Mar. 17	2,000	2	12.20	88.1	4.2	2,300	8.2	1,600	118	12
	•	8:15 A Apr. 7	1,380	14	8.90	85.8	2.6	750	8.2	390	167	20
	•	8:00 A Apr. 21	770	16	9.40	94.5	6.1	430	8.3	60	209	26
	•	8:15 A May 7	920	14	9.30	89.8	3.2	1,500	8.3	190	228	25
	•	8:15 A June 16	1,230	24	6.30	74.0	3.6	4,300	8.2	310	216	28
	•	7:15 A July 21	5,800	23	4.50	51.8	3.2	240,000	8.2	3,200	76	4.0
	•	7:45 A Aug. 18	3,400	25	6.30	75.2	2.2	240,000	7.8	3,200	86	8.5
	•	7:45 A Sept. 10	4,600	20	6.80	74.2	3.4	150,000	8.1	2,700	108	23
	•	7:30 A Oct. 6	480	15	8.60	84.8	1.6	23,000	8.3	190	195	25
	•	8:00 A Nov. 10	1,880	4	10.50	80.0	2.8	43,000	8.3	300	188	35
	•	8:15 A Dec. 17	475	0	14.00	95.7	3.8	4,300	8.3	80	233	32
Big Blue River Stockdale - County Bridge	B - 17.1	9:15 A June 30	4,880	22	5.30	60.0	3.0	93,000	7.8	4,700	79	8.0
	•	11:00 A July 30	1,090	25	6.70	80.0	1.6	43,000	8.4	800	146	13
	•	10:30 A Aug. 27	1,000	25	6.85	81.8	1.5	4,300	8.2	650	143	12
	•	11:00 A Sept.22	380	22	7.50	84.9	1.0	9,300	8.3	260	185	15
	•	11:00 A Oct. 29	384	12	9.65	89.0	2.2	930	8.3	110	219	34
	•	11:00 A Dec. 7	840	0	14.00	95.9	3.2	430	8.3	70	222	37
Big Blue River Bridge - Randolph St. Highway #16	B - 32.3	9:00 A June 30	4,160	22	5.50	62.2	2.1	43,000	7.6	4,400	84	9.0
	•	10:15 A July 30	1,870	25	5.30	63.2	3.4	93,000	8.4	1,700	139	9.5
	•	10:00 A Aug. 27	714	25	6.85	81.8	2.0	23,000	8.2	700	141	11
	•	10:30 A Aug. 22	440	22	7.40	83.8	1.6	9,300	8.3	250	171	16
	•	11:00 A Oct. 29	384	12	9.45	87.2	2.0	1,400	8.3	160	214	34
	•	10:30 A Dec. 7	840	0	13.60	93.0	3.0	4,300	8.3	85	222	38
	•											
Big Blue River Bridge - Cleburne	B - 41.4	8:45 A June 30	3,970	22	5.70	64.6	3.4	460,000	7.7	4,100	82	10
	•	9:30 A July 30	2,080	25	4.25	50.8	3.6	430,000	8.2	3,000	101	11
	•	9:30 A Aug. 27	718	25	6.90	82.3	1.6	23,000	8.2	650	143	14
	•	10:00 A Sept.22	480	22	7.40	83.8	2.3	9,300	8.3	240	168	17
	•	10:00 A Oct. 29	370	12	9.40	86.8	1.6	9,300	8.3	90	216	33
	•	10:15 A Dec. 7	800	0	13.30	91.0	3.6	2,300	8.3	95	226	36
Black Vermillion River Bridge - State Highway #13	B- 48.1 B.V. - 1.0	8:15 A June 30	800	20	5.70	62.2	2.9	23,000	7.6	2,500	86	6.0
	•	9:15 A July 30	400	24	2.85	33.4	3.7	460,000	7.8	5,300	76	3.0
	•	9:30 A Aug. 27	30	23	8.75	101.0	2.3	9,300	8.3	55	348	12
	•	9:45 A Sept.22	18	20	8.40	91.7	2.8	1,500	8.3	65	312	10
	•	9:30 A Oct. 29	20	11	7.75	69.9	6.6	2,300	8.1	55	372	17
	•	9:45 A Dec. 7	29	0	12.30	84.1	1.2	4,300	8.3	25	366	15
Black Vermillion River Bridge - west of Barrett	B - 48.1 B.V. - 14.0	7:45 A June 30	380	20	5.60	61.1	3.5	93,000	7.6	2,800	110	7.0
	•	8:45 A July 30	750	24	3.05	35.8	3.7	430,000	7.8	4,600	74	1.0
	•	8:30 A Aug. 27	28	23	5.45	62.8	3.3	75,000	8.2	80	350	16
	•	9:00 A Sept.22	11	20	4.90	53.6	2.7	15,000	8.1	95	320	15

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Black Vermillion	B - 48.1 B.V. - 14.0	9:00 A Oct. 29	16	11	4.70	42.4	4.6	23,000	8.1	80	374	19
River Bridge - west of	"	9:15 A Dec. 7	25	0	12.10	82.8	2.4	43,000	8.3	30	360	15
Barrett												
Black Vermillion	B - 48.1 B.V. - 16.5	7:30 A June 30	175	20	5.65	61.7	3.2	230,000	7.5	3,000	115	6.5
Bridge - State Highway 9 & 13	"	8:30 A July 30	800	24	2.90	34.0	3.5	230,000	7.6	4,600	74	2.0
	"	8:15 A Aug. 27	25	23	5.05	58.2	2.5	23,000	8.2	70	348	16
	"	8:45 A Sept.22	10	20	4.00	43.7	2.4	93,000	8.1	70	320	11
	"	8:45 A Oct. 29	15	11	3.60	32.5	3.7	23,000	8.1	65	369	16
	"	9:00 A Dec. 7	22	0	11.90	81.5	1.4	43,000	8.3	25	362	14
Black Vermillion	B - 48.1 B.V. - 18.0	7:00 A June 30	165	20	5.90	64.4	3.0	93,000	7.5	2,600	117	5.5
River Bridge - Frankfort	"	7:45 A July 30	740	24	2.35	27.6	4.1	460,000	7.6	4,300	71	2.5
	"	8:00 A Aug. 27	17	23	5.75	66.3	1.5	4,300	8.3	55	352	12
	"	8:15 A Sept.22	7	20	5.30	57.9	1.9	2,300	8.2	85	313	10
	"	8:15 A Oct. 29	15	11	4.85	43.8	3.2	9,300	8.1	75	363	13
	"	8:30 A Dec. 7	18	0	12.30	84.1	0.6	2,900	8.3	30	350	12
Big Blue River	B - 52.8	9:15 A June 23	700	22	6.90	78.2	2.6	9,300	8.3	500	189	34
Bridge - Irving, State Highway #13	"	9:45 A July 28	675	26	6.45	78.5	0.9	43,000	8.0	800	115	16
	"	9:45 A Aug. 20	1,725	25	6.75	80.5	1.8	75,000	8.1	2,300	66	6.0
	"	9:30 A Sept.15	600	21	7.15	79.6	1.2	43,000	7.9	1,300	97	10
	"	10:00 A Oct. 27	390	10	10.20	90.0	1.3	15,000	8.3	90	194	34
	"	10:30 A Dec. 1	575	1	13.30	93.5	2.4	2,300	8.3	80	216	28
Big Blue River	B - 59.5	7:30 A June 23	670	22	7.55	85.5	2.5	9,300	8.3	450	195	34
Bridge - Blue Rapids - U. S.	"	8:00 A July 28	635	26	6.90	84.0	0.7	43,000	8.1	600	110	17
Highway #77	"	8:15 A Aug. 20	1,750	25	7.05	84.2	1.9	240,000	8.0	2,300	65	5.0
	"	8:00 A Sept.15	600	21	7.70	85.7	1.0	23,000	7.9	1,200	102	12
	"	8:15 A Oct. 27	400	10	10.15	89.5	1.1	2,300	8.3	100	193	35
	"	9:00 A Dec. 1	490	1	13.00	91.3	1.6	9,300	8.3	80	205	28
Little Blue River	B - 61.8 L.B. - 1.0	8:30 A June 23	360	22	6.90	78.2	2.6	93,000	8.2	900	158	32
Bridge - 1 Mile above confluence	"	9:00 A July 28	230	26	6.45	78.5	1.3	9,300	8.3	700	131	20
with Big Blue	"	9:15 A Aug. 20	385	24	6.30	73.9	1.7	240,000	8.3	1,100	91	10
	"	9:15 A Sept.15	155	20	7.50	81.9	0.8	240,000	8.3	350	153	25
	"	9:30 A Oct. 27	130	9	9.60	82.8	1.2	4,300	8.3	85	201	35
	"	10:00 Dec. 1	190	0	13.10	89.6	0.8	7,500	8.3	120	192	31
Little Blue River	B - 61.8 L.B. - 4.1	8:15 A June 23	355	22	6.90	78.2	2.5	43,000	8.2	1,000	158	31
Bridge - East of Waterville	"	8:45 A July 28	230	26	6.60	80.3	1.2	23,000	8.3	650	128	22
	"	9:00 A Aug. 20	375	24	6.50	76.3	1.6	23,000	8.2	1,100	88	11
	"	8:45 A Sept.15	155	20	7.55	82.3	1.0	43,000	8.3	300	153	25
	"	9:15 A Oct. 27	129	9	9.80	84.6	1.4	4,300	8.3	95	200	36
	"	9:45 A Dec. 1	190	0	13.10	89.6	0.8	23,000	8.3	110	193	29

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Little Blue River	B - 61.8 L.B. - 6.2	8:00 A June 23	355	22	7.00	79.3	2.6	93,000	8.2	1,000	186	32
Bridge - North of Waterville	"	8:30 A July 28	232	26	6.45	78.3	0.9	4,300	8.3	700	131	22
	"	8:30 A Aug. 20	330	24	6.35	74.8	1.5	460,000	8.2	1,100	91	10
	"	8:30 A Sept.15	160	20	7.60	83.0	1.2	23,000	8.3	340	153	25
	"	8:45 A Oct. 27	129	9	9.40	81.1	1.3	2,300	8.3	110	199	36
	"	9:30 A Dec. 1	190	0	12.96	88.6	0.7	43,000	8.3	180	190	30
Little Blue River	B - 61.8 L.B. - 21.8	6:30 A June 23	220	21	6.66	74.0	3.0	93,000	8.0	3,900	99	18
Bridge - U. S. Highway #36	"	6:00 A July 28	175	28	6.30	76.8	2.1	93,000	8.2	560	132	26
Hanover, Kansas	"	6:00 A Aug. 20	290	24	6.46	75.6	1.6	93,000	8.2	1,000	93	16
	"	6:00 A Sept.15	140	20	7.56	82.4	1.4	15,000	8.1	230	159	31
	"	6:30 A Oct. 27	120	9	9.60	82.0	1.4	4,300	8.3	120	168	39
	"	7:00 A Dec. 1	173	0	12.96	88.6	1.6	9,300	8.3	130	189	31

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Mill Creek #3	B - 61.8 L.B. - 91.4	6:30 A Dec. 1	8	1	11.40	80.0	1.8	930	8.3	70	306	54
Bridge - U. S. Highway #36	M.C. #3 - 21.2											
0.5 mile east of Washington												
Little Blue River	B - 61.8 L.B. - 48.8	6:45 A July 19	250	24	6.91	81.1	4.2	-	7.8	800	141	27
County Bridge - Endicott	•	6:15 A July 26	190	23	6.52	75.2	2.5	-	7.6	900	114	22
	•	8:40 A Aug. 2	65	22	7.00	79.3	3.0	43,000	7.8	550	145	28
	•	8:00 A Aug. 9	230	23	6.80	78.4	2.5	110,000	7.5	1,200	89	18
	•	7:15 A Aug. 16	1,800	17	6.40	65.7	4.8	460,000	7.3	4,800	62	6.4
	•	1:45 P Aug. 24	180	28	7.40	93.4	3.8	93,000	8.2	240	158	37
	•	3:10 P Aug. 30	110	29	7.40	95.2	3.3	240,000	8.5	220	168	43
	•	3:30 P Sept. 1	100	31	9.00	120.0	6.0	93,000	-	-	-	-
	•	12:15 P Sept. 14	185	25	7.50	89.5	2.4	460,000	8.2	330	139	33
	•	12:15 P Sept. 28	140	17	8.62	88.5	2.3	430,000	8.1	550	116	27
	•	11:50 A Oct. 5	120	16	9.31	93.6	2.5	93,000	8.2	120	168	38
	•	9:45 A Dec. 9	140	2	13.27	95.8	3.4	24,000	7.9	100	174	31
	•	7:45 A Dec. 17	130	0	13.46	91.9	2.3	24,000	7.9	280	176	36
Rose Creek	B - 61.8 L.B. - 50.0	1:30 P Aug. 24	-	24	3.56	41.7	2.2	9,300	8.2	900	132	6.6
County Bridge - 1/2 mile south and	Ros.C. - 0.3 •	3:25 P Aug. 30	-	25	5.13	61.2	1.3	910	8.1	190	162	12
1 mile west of Endicott	•	12:30 P Sept. 14	4	25	7.20	85.9	3.0	2,400	8.2	230	172	13
	•	12:30 P Sept. 28	5	15	7.78	76.7	4.0	6,400	7.7	2,800	82	5.0
	•	12:15 P Oct. 5	4.8	14	8.14	78.5	2.3	2,400	8.0	320	141	16
	•	10:10 A Dec. 9	-	1	12.69	88.7	1.6	430	8.0	65	270	31
	•	8:05 A Dec. 17	-	0	13.16	89.9	1.8	240	7.9	35	271	33
Little Blue River	B - 61.8 L.B. - 51.8	7:25 A July 19	860	24	6.61	77.6	3.6	-	7.7	1,200	139	18
Bridge - county road - 1 mile	•	6:35 A July 26	180	23	6.80	78.3	2.6	-	7.8	800	124	22
north and 2 miles west of Endicott	•	9:10 A Aug. 2	166	23	7.01	80.8	2.8	1,500	7.9	500	143	26
	•	8:30 A Aug. 9	244	23	7.12	82.1	3.0	110,000	7.3	1,300	88	19
	•	8:00 A Aug. 16	1,400	17	6.95	71.4	4.7	>110,000	7.1	4,000	32	5.8
	•	1:15 P Aug. 24	188	28	7.43	93.8	4.1	93,000	8.3	230	162	37
	•	3:40 P Aug. 30	106	29	7.97	102.6	5.6	240,000	8.2	210	170	49
	•	11:45 A Sept. 1	93	27	7.40	91.7	-	240,000	-	-	-	-
	•	12:45 P Sept. 14	126	26	7.45	90.6	1.8	43,000	8.1	330	144	36
	•	12:45 P Sept. 28	127	18	8.58	89.9	1.8	23,000	8.1	330	142	32
	•	12:30 P Oct. 5	110	17	9.70	99.6	2.0	43,000	8.3	130	167	35
	•	10:20 A Dec. 9	130	0	13.64	93.3	1.6	240,000	7.9	80	168	34
	•	8:20 A Dec. 17	120	0	13.40	91.6	1.3	4,600	7.9	90	171	38
Little Blue River	B - 61.8 L.B. - 53.4	9:35 A Aug. 2	180	23	7.17	81.8	3.0	110,000	7.9	600	150	16
1 mile east on access road from	•	8:55 A Aug. 9	215	23	7.08	81.7	2.4	46,000	7.3	1,200	95	13
State Highway 15 2 miles south of	•	8:20 A Aug. 16	1,200	17	7.06	72.6	4.4	240,000	7.2	1,200	39	3.9
Fairbury	•	12:50 P Aug. 24	180	27	7.41	91.8	6.2	1,100,000	8.4	180	161	22
	•	3:45 P Aug. 30	100	29	7.49	96.4	>7.5	750,000	8.3	110	172	26
	•	1:35 P Sept. 1	90	30	9.27	121.5	6.8	240,000	-	-	-	-

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Little Blue River	B - 61.8 L.B. - 53.4	1:00 P Sept.14	125	24	6.63	77.7	3.2	93,000	8.1	290	145	23
1 mile east on access road from	•	1:00 P Sept.28	125	19	8.00	85.6	3.5	430,000	8.1	280	152	18
State Highway 15 2 miles south of	•	12:45 P Oct. 5	110	17	9.11	93.5	4.6	150,000	8.2	100	167	22
Fairbury												
Little Blue River	B - 61.8 L.B. - 55.4	2:40 P Aug. 30	96	28	7.17	90.5	>7.2	>110,000	8.3	170	172	26
Bridge - State Highway #15 -	•	2:50 P Sept. 1	90	29	9.05	116.5	-	430,000	-	-	-	-
1 mile south of Fairbury	•	1:15 P Sept.14	120	23	6.99	80.5	3.8	750,000	8.1	270	146	20
	•	11:55 A Sept.28	120	17	8.08	83.0	4.6	230,000	8.0	260	172	18
	•	11:30 A Oct. 5	105	16	8.81	88.5	5.1	750,000	8.2	250	169	22
	•	8:45 A Dec. 17	115	0	13.46	92.0	2.5	24,000	7.8	95	171	20
Little Blue River	B - 61.8 L.B. - 57.0	8:30 A July 19	450	24	6.70	78.6	4.7	-	7.4	6,000	107	9.0
Bridge - State Highway #15 on	•	7:10 A July 26	173	24	7.10	83.3	2.7	-	7.8	650	118	13
southwest side of Fairbury	•	9:55 A Aug. 2	145	23	6.87	79.2	5.8	>110,000	7.8	500	151	15
	•	9:45 A Aug. 9	210	24	7.00	82.2	4.9	110,000	7.3	1,300	93	13
	•	8:50 A Aug. 16	1,000	17	7.30	75.0	4.8	110,000	7.1	3,600	35	4.4
	•	12:35 P Aug. 24	140	25	7.73	92.2	3.7	24,000	8.5	220	161	19
	•	7:45 A Sept. 1	85	25	6.72	80.2	-	24,000	-	-	-	-
	•	11:00 A Dec. 9	125	0	13.45	92.0	3.3	11,000	7.9	260	166	16
	•	9:00 A Dec. 17	115	0	16.50	112.8	>7.7	150	8.3	100	213	64
Little Blue River	B - 61.8 L.B. - 59.0	8:55 A July 19	480	24	6.19	72.6	4.3	-	7.4	7,000	121	9
Bridge - State Highway 3 -	•	8:00 A July 26	166	24	7.49	87.7	1.9	-	7.9	600	121	13
West of Fairbury	•	10:20 A Aug. 2	140	21	7.35	81.7	2.2	110,000	7.9	600	141	12
	•	10:05 A Aug. 9	220	23	7.46	85.9	2.2	110,000	7.4	1,200	92	11
	•	9:20 A Aug. 16	600	17	6.41	66.0	5.4	460,000	7.3	3,000	41	4.9
	•	12:10 P Aug. 24	135	25	8.09	96.5	4.3	4,300	8.5	220	160	17
	•	11:25 A Aug. 30	90	25	7.30	87.1	2.7	2,300	8.4	200	162	21
	•	6:25 A Sept. 1	85	25	6.96	83.1	-	9,300	-	-	-	-
	•	11:30 A Sept.14	115	24	7.98	93.6	1.3	7,500	8.1	290	144	16
	•	11:30 A Sept.28	115	17	9.13	93.7	1.4	9,300	8.2	270	154	16
	•	11:00 A Oct. 5	100	14	10.09	97.3	1.4	<360	8.3	95	167	19
	•	11:30 A Dec. 9	120	0	13.27	90.6	1.6	2,400	7.9	110	160	14
	•	9:15 A Dec. 17	110	0	13.70	93.6	0.7	4,600	8.0	45	170	19
Little Blue River	B - 61.8 L.B. - 84.4	9:40 A July 19	550	22	6.08	68.9	4.3	-	7.3	7,200	66	1.4
Bridge - 4 miles east of Hebron	•	8:40 A July 26	[illegible]	24	7.50	87.9	2.2	-	8.2	450	144	13
	•	11:10 A Aug. 2	350	16	6.94	69.7	>6.9	1,100,000	6.8	4,500	63	5.0
	•	11:00 A Aug. 9	135	23	6.93	79.8	1.7	9,100	7.2	800	111	9.2
	•	10:10 A Aug. 16	210	19	6.80	72.8	4.7	240,000	7.3	1,600	89	5.0
	•	11:25 A Aug. 24	85	24	6.42	75.3	4.3	93,000	8.2	1,500	176	10
	•	10:50 A Aug. 30	75	25	7.02	83.8	2.2	43,000	8.2	130	175	11
	•	Sept. 7	65	20	7.31	79.7	4.6	-	8.1	600	154	9.2
	•	11:00 A Sept.14	90	22	8.02	90.8	1.3	23,000	8.2	260	166	10
	•	10:45 A Sept.28	75	17	9.10	93.4	1.2	43,000	8.3	140	175	10

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Little Blue River	B - 61.8 L.B. - 84.4	10:30 A Oct. 5	75	15	9.50	93.6	1.6	15,000	8.3	90	175	10
Bridge - 4 miles east of Hebron	"	9:55 A Dec. 17	80	0	13.12	89.7	1.4	4,600	8.0	85	175	11
Little Blue River Along Highway -	B - 61.8 L.B. - 86.8	11:00 A Aug. 24	80	23	6.31	72.7	3.6	15,000	8.3	1,200	170	11
two miles east of Hebron	"	10:30 A Aug. 30	80	25	7.06	84.2	2.4	9,300	8.3	130	176	11
	"	10:45 A Sept.14	88	22	7.92	89.7	1.3	43,000	8.3	240	165	10
	"	10:25 A Sept.28	70	18	8.96	93.9	0.9	240,000	8.3	120	170	9.0
	"	10:15 A Oct. 5	70	15	9.43	92.9	1.4	9,100	8.3	95	172	10
	"	10:05 A Dec. 17	80	0	13.39	91.5	1.2	2,400	7.9	120	178	11
Little Blue River	B - 61.8 L.B. - 8[illegible]	10:35 A July 19	680	22	5.42	61.4	>5.4	-	7.2	9,000	58	1.8
Bridge - U. S. Highway #81 -	"	9:40 A July 26	110	24	7.13	83.5	1.7	-	8.3	450	144	4.5
Southeast of Hebron	"	11:50 A Aug. 2	180	23	7.02	81.0	3.9	110,000	7.3	1,600	105	7.1
	"	11:40 A Aug. 9	185	23	6.90	79.5	3.1	110,000	7.4	650	117	8.8
	"	10:25 A Aug. 16	200	20	6.85	74.7	4.4	>110,000	7.4	1,300	76	6.5
	"	10:45 A Aug. 24	75	22	6.03	68.3	4.4	210,000	8.1	1,600	176	11
	"	9:45 A Aug. 30	80	25	6.21	74.1	2.1	93,000	8.3	120	174	11
	"	9:00 A Sept. 7	80	22	6.84	77.5	2.9	-	8.2	170	164	10
	"	10:30 A Sept.14	88	21	7.70	85.7	2.0	240,000	8.2	280	168	11
	"	10:05 A Sept.28	70	17	8.99	92.3	1.7	93,000	8.2	140	174	10
	"	10:00 A Oct. 5	70	15	9.01	88.8	1.9	93,000	8.3	85	175	10
	"	12:30 P Dec. 9	88	0	13.61	93.1	1.4	75,000	7.9	60	173	10
	"	10:10 A Dec. 17	76	0	13.19	90.1	1.6	>11,000	7.9	100	178	11
Spring Creek	B - 61.8 L.B. - 88.6	11:05 A July 19	9.0	24	6.46	75.8	4.2	-	7.3	2,100	58	1.2
Bridge - County road 1/2 mile	Sp.C. - 1.1	9:15 A July 26	1.8	24	6.81	81.4	1.8	-	7.7	240	114	8.4
south of Hebron	"	12:25 P Aug. 2	2.0	24	5.69	66.8	>5.7	>110,000	7.0	2,300	76	[illegible]
	"	11:55 A Aug. 9	0.8	25	10.80	129.0	6.8	3,600	8.1	45	171	13
	"	10:45 A Aug. 16	180	20	6.65	72.5	4.9	240,000	7.0	2,500	28	3.5
	"	10:25 A Aug. 24	1.0	25	8.00	95.5	2.6	9,300	8.7	60	130	7.2
	"	10:00 A Aug. 30	0.8	25	8.28	98.8	3.8	9,300	8.4	30	161	10
	"	9:45 A Sept. 7	1.0	18	7.17	75.2	5.2	-	7.7	70	148	9.7
	"	10:00 A Sept.14	1.0	21	9.10	101.2	2.2	4,300	8.2	80	137	8.8
	"	9:25 A Sept.28	1.2	14	8.82	84.9	1.3	46,000	7.7	100	118	8.1
	"	9:30 A Oct. 5	0.8	13	10.31	97.3	1.7	2,100	8.2	10	159	11
	"	10:55 A Dec. 17	1.8	0	13.02	89.0	1.2	>1,100	7.6	15	180	14
Spring Creek	B - 61.8 L.B. - 88.6	1:20 P July 19	3.8	24	5.60	65.7	4.2	-	7.2	1,100	57	8.3
Bridge - State highway #3, 3 miles	Sp.C. - 6.6 "	9:35 A July 26	0.4	25	6.68	79.7	2.9	-	7.7	310	119	5.0
east of Deshler	"	1:00 P Aug. 2	0.8	26	10.70	130.0	6.6	2,300	7.9	65	132	7.0
	"	12:25 P Aug. 9	0.2	25	10.60	127.0	3.9	730	8.4	35	149	11
	"	11:00 A Aug. 16	110	20	6.56	71.5	5.3	110,000	7.0	2,200	24	2.5
	"	9:35 A Aug. 24	0.3	22	5.17	58.6	2.6	43,000	8.1	240	100	6.6
	"	9:30 A Aug. 30	0.2	23	6.59	75.9	3.4	9,300	8.3	80	161	11
	"	10:25 A Sept. 7	1.0	13	6.50	68.1	>6.5	-	7.3	1,600	93	5.9
	"	9:10 A Sept.28	0.4	13	8.03	75.8	2.3	46,000	8.0	85	121	7.9

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Spring Creek	B - 61.8 L.B. - 88.6	9:15 A Oct. 5	0.8	13	7.97	75.2	3.0	110,000	7.7	70	118	7.6
Bridge - State Highway #3, 3 miles	Sp.C. - 6.6 "	11:15 A Dec. 17	0.6	6	12.44	85.1	1.9	1,100	7.5	20	144	13
east of Deshler												
Spring Creek	B - 61.8 L.B. - 88.6	11:50 A July 19	2.9	24	5.08	59.6	5.1	-	7.2	1,900	68	1.1
Bridge - 1 mile east of Deshler &	Sp.C. - 9.0 "	9:55 A July 26	0.1	25	4.02	48.0	4.8	-	7.6	370	98	0.4
1 mile south of Highway #3	"	1:20 P Aug. 2	0.08	24	8.28	97.2	3.7	9,100	7.0	70	96	3.9
	"	11:15 A Aug. 16	108	20	6.66	72.6	6.0	1,100,000	6.8	2,300	21	1.6
	"	9:20 A Aug. 24	0.01	22	3.16	35.8	2.1	24,000	7.5	90	84	2.2
	"	9:15 A Aug. 30	0.01	24	4.91	57.6	4.3	15,000	7.8	100	116	7.5
	"	10:10 A Sept. 7	1.0	18	4.59	48.1	3.5	-	7.3	200	98	2.4
	"	9:05 A Sept.14	0	18	1.70	17.8	3.3	24,000	7.3	75	84	2.5
	"	8:45 A Sept.28	0	12	3.70	34.2	1.3	2,300	7.6	25	107	3.3
	"	9:00 A Oct. 5	0	12	4.47	41.3	2.4	2,300	7.5	25	102	4.0
	"	11:35 A Dec. 17	0	0	14.24	97.4	1.6	460	7.4	20	128	13
Little Blue River	B - 61.8 L.B. - 89.5	9:15 A Sept. 7	86	21	7.21	80.2	1.4	-	8.2	140	173	9.2
City Route - State Highway #81 - west	"	10:15 A Sept.14	86	21	7.78	86.5	0.8	3,900	8.1	270	165	10
side of Hebron	"	9:45 A Sept.28	66	16	9.09	91.4	0.8	1,500	8.2	140	177	10
	"	9:45 A Oct. 5	70	14	9.31	89.8	1.3	730	8.3	100	182	8.7
	"	12:45 P Dec. 9	86	0	13.45	92.0	1.3	140	7.9	55	176	9.9
	"	10:50 A Dec. 17	75	0	13.12	89.7	0.7	240	7.9	70	180	10
Big Blue River	B - 70.3	7:00 A June 23	330	21	6.55	72.9	1.7	23,000	8.2	90	241	44
Bridge - west of Schroyer	"	7:45 A July 28	400	26	6.00	73.0	1.1	240,000	8.0	900	97	16
	"	7:45 A Aug. 20	1,380	25	6.50	77.5	1.8	75,000	7.8	2,400	53	3.5
	"	7:30 A Sept.15	480	21	6.50	72.2	1.4	240,000	7.5	1,600	86	6.0
	"	8:00 A Oct. 27	270	10	9.50	83.7	1.5	23,000	8.1	110	174	36
	"	8:30 A Dec. 1	300	1	12.25	86.0	2.4	9,300	8.3	60	206	26
Big Blue River	B - 77.5	6:45 A June 23	342	21	6.90	76.8	3.4	23,000	8.3	85	238	44
No Bridge - U.P. RR tracks along east	"	7:15 A July 28	382	26	6.10	74.1	1.4	43,000	8.0	800	91	16
bank of River 2 miles south of Marysville	"	7:15 A Aug. 20	1,380	25	6.25	74.6	1.7	23,000	7.6	2,300	50	3.0
	"	7:15 A Sept.15	406	21	7.05	78.3	1.4	43,000	7.5	1,400	81	4.0
	"	7:45 A Oct. 27	265	10	9.35	82.4	2.2	23,000	8.1	95	186	39
	"	8:15 A Dec. 1	306	1	12.45	87.5	3.2	2,300	8.3	60	206	29
Big Blue River	B - 79.3	6:00 A June 23	340	21	7.30	81.2	2.6	2,300	8.3	70	231	44
No bridge - Road along west side of	"	6:30 A July 28	380	26	6.55	79.7	0.8	9,300	8.1	800	90	18
river, 1 mile south of U.S. Highway #36	"	6:30 A Aug. 20	1,380	24	6.95	81.5	1.2	110,000	7.6	2,300	49	3.0
	"	6:30 A Sept.15	400	21	7.30	81.2	1.6	43,000	7.6	1,400	82	2.0
	"	7:15 A Oct. 27	288	10	9.75	86.0	2.0	7,500	8.1	100	185	33
	"	7:30 A Dec. 1	300	1	12.60	88.5	3.2	2,300	8.3	55	198	30
Big Blue River	B - 80.0	6:15 A June 23	340	21	7.40	82.3	1.1	4,300	8.3	90	235	46
Bridge - West of Marysville	"	6:45 A July 28	390	26	6.70	81.6	0.4	15,000	8.1	800	91	18
	"	7:00 A Aug. 20	1,380	26	6.95	84.6	1.8	43,000	7.8	2,500	52	4.0

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Big Blue River	B - 80.6	6:45 A Sept.15	400	21	7.30	81.2	1.2	4,300	7.7	1,600	76	5.0
Bridge - West of Marysville	"	7:30 A Oct. 27	385	10	10.00	88.3	1.5	1,400	8.2	100	106	33
	"	7:45 A Dec. 1	300	1	12.60	88.5	3.1	430	8.3	55	200	29
Big Blue River	B - 101.9	9:00 A Aug. 23	884	27	4.80	59.5	1.9	15,000	7.6	1,200	60	9.3
Bridge - State Highway #3, South of	"	2:15 P Sept.13	380	20	6.08	66.3	2.4	23,000	7.3	1,800	58	4.5
Barston, Nebraska	"	10:05 A Sept.20	251	23	5.30	61.1	1.4	2,300	7.7	280	96	11
	"	9:20 A Sept.27	275	17	6.70	68.8	1.6	2,300	8.1	110	135	31
	"	8:50 A Oct. 13	233	11	7.40	66.8	1.1	4,300	7.7	340	103	17
	"	3:00 P Oct. 21	231	11	7.87	71.1	1.7	1,500	7.7	150	156	33
	"	12:45 P Nov. 1	235	11	10.10	91.3	5.7	24,000	8.1	95	206	24
	"	11:45 A Nov. 30	227	1	13.40	94.1	3.1	1,500	8.1	35	191	55
	"	1:25 P Dec. 22	245	2	13.20	95.3	2.2	430	7.8	25	207	43
Big Blue River	B - 109.0	9:30 A Aug. 23	-	27	5.55	68.8	1.7	43,000	8.0	900	80	7.1
Bridge - 1½ miles below confluence of	"	1:50 P Sept.13	-	21	6.52	72.5	2.7	23,000	7.3	1,400	69	5.2
Big Indian Creek	"	10:30 A Sept.20	-	23	5.41	62.3	1.9	9,100	8.1	210	124	21
	"	9:50 A Sept.27	-	17	6.50	66.7	1.5	4,300	8.0	160	153	31
	"	9:10 A Oct. 13	-	11	7.63	68.9	1.4	9,300	7.7	270	143	31
	"	2:40 P Oct. 21	-	11	8.93	80.6	2.8	2,300	7.9	210	200	30
	"	12:15 P Nov. 1	-	11	9.56	86.4	6.2	36	8.1	100	224	26
	"	11:20 A Nov. 30	-	1	11.91	83.8	3.0	>11,000	8.0	50	206	27
	"	1:05 P Dec. 22	-	2	13.37	96.5	2.5	4,600	7.9	30	216	26
Big Indian Creek	B - 110.4 B.I.C. - 0.7	9:45 A Aug. 23	-	25	4.94	58.9	4.1	43,000	8.1	310	117	9.1
Bridge - U.S. Highway #77, Wymore	"	1:30 P Sept.13	-	23	5.82	67.1	5.8	43,000	7.6	1,100	89	5.2
	"	10:45 A Sept.20	-	23	6.22	71.7	7.9	7,300	8.3	150	133	10
	"	10:05 A Sept.27	1.6	14	7.18	69.2	15.6	43,000	8.3	310	178	16
	"	9:00 A Oct. 6	1.8	15	7.10	70.0	29.5	240,000	8.1	200	153	15
	"	9:25 A Oct. 13	1.2	10	9.46	83.4	4.3	4,300	8.1	80	232	17
	"	2:25 P Oct. 21	-	10	12.88	113.4	6.2	<300	8.0	45	242	22
	"	12:15 P Nov. 1	-	11	6.30	56.9	5.7	9,300	8.1	200	276	16
	"	11:15 A Nov. 30	-	1	11.29	79.2	2.4	930	7.7	45	194	12
	"	12:55 P Dec. 22	2.0	2	15.13	109.2	7.4	360	8.0	50	288	19
Big Indian Creek	B - 110.4	10:00 A Aug. 23	-	26	5.17	62.9	4.0	15,000	8.2	220	132	5.6
County Bridge - above Wymore	B.I.C. - 4.0	1:15 P Sept.13	-	23	6.04	69.6	3.9	43,000	7.4	1,000	91	3.1
	"	11:05 A Sept.20	-	23	7.20	82.9	3.7	3,600	8.1	130	164	6.7
	"	10:35 A Sept.27	-	16	9.60	96.5	3.1	910	8.1	60	211	8.3
	"	9:40 A Oct. 13	-	10	10.02	88.4	3.9	930	8.2	85	272	13
	"	2:10 P Oct. 21	-	10	11.24	99.1	6.1	230	7.9	50	290	13
	"	12:00 N Nov. 1	-	11	3.93	35.5	12.2	4,300	7.7	60	268	10
	"	10:50 A Nov. 30	-	1	11.60	81.5	2.6	4,600	7.7	50	198	10
	"	12:45 P Dec. 22	-	2	17.54	126.7	1.3	230	8.0	20	304	15

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Big Blue River County Bridge at Blue Springs	B - 112.5	10:30 A Aug. 23	-	28	4.99	60.7	1.3	43,000	8.0	800	84	7.7
	"	12:30 P Sept.13	-	21	6.19	68.9	2.5	23,000	7.3	1,100	72	5.2
	"	11:25 A Sept.20	-	26	5.46	64.0	1.4	15,000	8.1	190	120	19
	"	10:35 A Sept.27	770	17	6.25	64.2	2.7	2,300	7.9	140	158	40
	"	9:55 A Oct. 13	280	11	8.36	75.6	3.0	9,300	8.1	220	150	30
	"	3:00 P Oct. 21	-	11	8.42	76.1	3.5	4,300	7.9	180	196	27
	"	11:45 A Nov. 1	-	11	9.50	85.8	7.1	1,500	8.0	120	225	25
	"	10:40 A Nov. 30	-	1	11.80	82.9	3.1	11,000	7.8	55	205	32
	"	12:35 P Dec. 22	280	2	13.32	96.3	2.8	4,600	7.9	25	222	28
Big Blue River No bridge - 0.7 mile below mouth of Bear Creek	B - 128.2	11:30 A Aug. 23	-	27	6.06	75.1	1.8	24,000	7.8	1,200	68	8.6
	"	11:30 A Sept.13	-	21	6.81	75.8	2.8	93,000	7.7	800	97	11
	"	11:55 A Sept.20	-	24	5.13	60.1	2.4	43,000	8.0	270	132	31
	"	11:35 A Sept.27	-	17	8.29	85.1	4.2	43,000	7.7	3,300	94	22
	"	10:35 A Oct. 13	-	11	8.47	76.5	3.3	240,000	7.6	380	158	33
Big Blue River Suspension Bridge Northern Natural Gas Co.	B - 128.1	12:00 N Sept.13	-	21	6.50	72.3	3.0	75,000	7.4	800	93	10
	"	12:45 P Sept.20	-	23	5.70	65.7	3.9	43,000	8.1	210	133	30
	"	11:55 A Sept.27	-	16	7.80	78.4	3.9	240,000	7.9	2,400	108	28
	"	10:50 A Oct. 13	-	12	7.78	71.8	3.1	240,000	7.8	250	138	29
	"	1:10 P Oct. 21	-	10	8.77	77.3	3.6	110,000	7.9	100	200	49
	"	11:00 A Nov. 1	-	11	5.11	46.2	3.9	380	8.1	150	222	27
Big Blue River Bridge - U. S. Highway 77 - Beatrice	B - 130.0	12:05 P Aug. 23	-	27	5.20	64.4	2.3	93,000	7.4	1,100	66	12
	"	10:35 A Sept.13	-	20	6.36	69.4	2.8	43,000	7.7	600	99	10
	"	1:05 P Sept. 20	-	25	5.84	69.7	3.4	460,000	8.1	220	135	33
	"	12:25 P Sept. 27	-	16	7.89	79.3	3.4	93,000	8.1	1,000	141	28
	"	9:30 A Oct. 6	-	14	4.78	46.1	>27.0	>1,100,000	7.7	400	138	36
	"	11:10 A Oct. 13	280	12	8.85	81.7	2.2	150,000	8.0	200	157	38
	"	12:45 P Oct. 21	-	11	10.87	98.2	4.0	24,000	7.9	110	208	84
	"	10:30 A Nov. 1	-	11	6.66	60.2	4.3	910	7.9	160	218	12
	"	9:50 A Nov. 30	-	1	12.47	87.5	4.3	9,300	8.1	70	214	41
	"	10:30 A Dec. 22	-	2	12.34	89.2	1.7	24,000	7.9	25	224	41
Big Blue River Bridge - Court Street - Beatrice	B - 131.1	12:20 P Aug. 23	-	27	5.86	72.6	1.6	43,000	7.7	1,000	69	12
	"	10:20 A Sept.13	-	20	6.37	69.5	1.9	23,000	7.6	600	100	10
	"	1:20 P Sept.20	-	24	6.97	81.7	2.2	110,000	8.2	170	134	28
	"	12:35 P Sept.27	-	16	8.35	85.9	2.4	9,100	8.1	390	156	19
	"	9:45 A Oct. 6	-	14	8.04	77.5	1.5	9,300	7.8	330	107	37
	"	11:30 A Oct. 13	-	11	9.10	82.2	1.8	9,300	8.0	190	155	35
	"	12:30 P Oct. 21	-	11	10.75	97.2	3.3	36	7.9	100	210	61
	"	10:10 A Nov. 1	-	12	7.44	68.6	4.6	930	8.0	140	215	19
	"	9:35 A Nov. 30	-	1	12.76	89.6	3.3	11,000	8.1	60	212	40
	"	10:20 A Dec. 22	-	2	12.47	90.0	1.4	430	7.9	25	219	32

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Big Blue River	B - 128.7	12:45 P Aug. 23	-	28	6.81	70.7	1.7	24,000	7.9	1,100	71	11
County Bridge - West of Beatrice	"	9:55 A Sept.13	-	20	6.82	74.4	2.4	24,000	7.6	900	84	11
	"	1:40 P Sept.20	-	24	6.48	78.0	1.7	2,300	8.2	190	158	42
	"	1:00 P Sept.27	-	18	8.23	88.7	2.6	4,300	8.2	700	100	12
	"	12:00 N Oct. 13	-	13	9.18	86.8	1.6	4,300	8.0	200	181	24
	"	12:00 N Oct. 21	-	11	10.46	94.4	3.5	<300	7.9	130	211	43
	"	9:45 A Nov. 1	-	11	8.26	75.4	5.1	430	8.1	140	220	21
	"	9:15 A Nov. 30	-	1	12.71	89.4	3.4	2,400	8.1	60	212	32
	"	10:10 A Dec. 22	-	2	12.63	91.5	1.5	230	7.9	25	214	36
Turkey Creek	B - 132.7 Tu.C. - 0.7	1:10 P Aug. 23	25	27	6.20	78.9	2.2	24,000	8.0	1,000	68	21
Bridge - State Highway 82 -	"	9:00 A Sept.13	38	19	7.32	78.3	2.6	43,000	7.2	1,800	38	3.2
DeWitt	"	2:00 P Sept.20	16	23	6.70	77.2	1.9	9,300	8.1	350	100	40
	"	1:50 P Sept.27	20	16	8.22	82.6	4.1	24,000	7.7	3,500	62	17
	"	12:30 P Oct. 13	18	12	10.99	101.2	2.5	360	8.2	100	197	50
	"	11:45 A Oct. 21	15	9	10.41	89.9	3.1	360	7.6	230	213	65
	"	9:30 A Nov. 1	20	10	7.62	67.2	4.6	2,400	7.7	140	211	29
	"	9:00 A Nov. 30	20	0	12.90	88.2	2.4	4,600	7.7	100	161	48
	"	9:50 A Dec. 22	20	1	13.29	95.3	0.8	91	7.9	30	216	50
Turkey Creek	B - 132.7 Tu.C. - 18.1	8:00 A Sept.13	-	17	7.24	74.3	3.2	43,000	7.2	1,500	37	4.0
Bridge - State Highway 41 -	"	3:00 P Sept.20	-	22	6.30	71.3	1.8	9,300	8.3	240	132	11
3½ miles west of Wilber	"	3:15 P Sept.27	-	16	9.09	91.4	1.6	9,300	8.5	190	191	11
	"	1:30 P Oct. 13	-	12	10.12	93.4	3.0	360	8.3	100	208	11
	"	10:15 A Oct. 21	-	9	8.50	73.4	4.3	360	7.8	80	213	11
	"	8:20 A Nov. 1	-	10	5.77	50.8	12.1	930	7.7	150	211	7.6
	"	7:55 A Nov. 30	-	0	12.84	87.8	2.7	430	7.9	50	170	10
	"	8:40 A Dec. 22	-	0	12.62	85.6	0.9	73	7.9	20	228	13
Big Blue River	B - 152.7	1:30 P Aug. 23	-	26	5.54	67.4	1.3	43,000	7.7	1,100	64	14
Bridge at DeWitt	"	9:20 A Sept.13	-	20	6.54	71.3	2.2	43,000	7.7	240	132	19
	"	2:15 P Sept.20	-	23	6.65	76.5	3.4	3,600	8.3	140	158	26
	"	2:10 P Sept.27	-	17	8.33	86.5	2.6	9,300	8.3	320	195	12
	"	12:40 P Oct. 13	-	13	9.62	92.6	2.4	2,300	8.1	130	188	16
	"	11:30 A Oct. 21	-	10	10.19	89.9	3.8	930	7.9	150	217	25
	"	9:05 A Nov. 1	-	11	8.15	73.6	5.0	24,000	8.1	130	228	22
	"	8:40 A Nov. 30	-	1	12.82	88.0	2.8	4,600	8.0	50	228	56
	"	9:35 A Dec. 22	-	[illegible]	13.37	93.8	1.6	11,000	7.9	25	229	25
Big Blue River	B - 164.2	1:55 P Aug. 23	-	[illegible]	5.24	64.9	1.8	43,000	7.7	1,200	71	6.0
County Bridge - 5 miles west of	"	8:35 A Sept.13	-	[illegible]	6.60	69.5	2.7	43,000	7.6	360	116	7.0
Clatonia	"	2:35 P Sept.20	-	22	6.58	74.5	2.5	43,000	8.2	210	170	13
	"	2:35 P Sept.27	-	16	8.31	83.5	2.5	39,000	8.1	1,300	124	8.1
	"	1:00 P Oct. 13	-	12	9.24	86.2	3.1	9,300	8.1	240	199	11
	"	11:00 A Oct. 21	-	9	9.63	83.1	3.4	4,600	7.9	100	235	14

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
Big Blue River County Bridge - 5 miles west of Clatonia	B - 164.2	8:45 A Nov. 1	-	11	7.22	65.3	5.8	110,000	7.7	100	220	12
	"	8:15 A Nov. 30	-	1	12.35	86.7	2.1	11,000	8.0	40	208	14
	"	9:15 A Dec. 22	-	2	11.85	88.2	1.2	4,600	7.9	25	246	15
Big Blue River Bridge - State Highway 41 - Wilber	B - 167.1	2:10 P Aug. 23	250	26	5.36	65.2	1.6	43,000	7.7	1,800	68	6.6
	"	8:30 A Sept.13	130	19	6.11	65.8	2.2	43,000	7.8	280	108	7.1
	"	2:45 P Sept.20	100	23	6.54	75.3	3.6	43,000	8.[illegible]	100	161	11
	"	2:55 P Sept.27	200	16	8.28	83.2	4.5	93,000	8.1	1,300	117	7.7
	"	1:15 P Oct. 13	140	12	9.25	85.4	2.8	43,000	8.0	100	194	12
	"	10:40 A Oct. 21	110	10	8.62	76.0	2.8	9,300	7.9	90	230	13
	"	8:00 A Nov. 1	-	11	5.21	47.1	5.8	4,300	7.6	130	220	9.0
	"	7:35 A Nov. 30	160	1	12.51	87.8	3.2	4,600	8.1	25	218	12
	"	9:00 A Dec. 22	100	2	12.09	87.3	1.3	4,600	7.8	25	254	14
Big Blue River Bridge - State Highway 82 - South of Crete	B - 180.8	7:25 A Aug. 20	-	24	6.29	73.7	4.6	24,000	7.3	1,400	68	7.0
	"	12:30 P Sept. 9	-	19	6.60	72.7	3.0	24,000	7.7	460	121	6.9
	"	11:15 A Sept.16	-	21	4.60	53.4	2.3	>110,000	8.0	210	175	10
	"	11:50 A Sept.23	-	17	5.25	53.9	2.7	930,000	7.5	110	188	11
	"	1:05 P Sept.30	-	17	5.80	59.5	3.8	93,000	7.7	1,800	75	3.2
	"	12:35 P Oct. 5	-	14	5.92	57.1	2.5	240,000	8.1	600	136	6.6
	"	1:30 P Oct. 12	-	12	8.59	79.2	4.0	43,000	8.0	60	214	13
	"	3:55 P Oct. 25	-	11	8.76	79.1	6.9	240,000	7.8	60	254	11
	"	8:15 A Dec. 20	-	1	10.49	73.7	1.4	46,000	7.7	10	252	14
Big Blue River No Bridge - 1 mile south of Crete	B - 181.7	12:30 P Sept.9	-	19	6.74	72.1	3.4	240,000	7.7	400	133	6.2
	"	11:30 A Sept.16	-	21	5.10	56.7	3.8	23,000	8.0	240	140	7.5
	"	12:00 N Sept.23	-	18	4.96	51.9	3.0	24,000	7.7	180	170	9.2
	"	1:15 P Sept.30	-	16	5.55	55.8	3.4	240,000	7.7	1,300	97	4.0
	"	12:30 P Oct. 5	-	15	5.18	51.0	4.1	1,100,000	7.7	800	131	7.7
	"	1:40 P Oct. 12	-	12	8.91	82.3	5.1	93,000	8.1	95	200	12
	"	3:45 P Oct. 28	-	10	11.16	98.4	6.4	46,000	8.0	[illegible]	226	11
	"	8:35 A Dec. 20	-	1	10.02	70.4	2.4	110,000	7.6	15	248	12
Big Blue River Bridge - State Highway #33 at Crete	B - 183.6	8:35 A Aug. 20	-	25	6.14	73.3	2.6	24,000	7.3	1,300	56	3.4
	"	12:00 N Sept. 9	-	18	6.31	66.1	4.1	43,000	7.7	450	126	5.9
	"	11:45 A Sept. 16	-	22	4.65	54.9	2.4	4,300	8.0	280	134	5.0
	"	11:30 A Sept. 23	-	18	4.45	46.6	2.4	910	7.9	180	168	9.1
	"	12:50 P Sept. 30	-	15	5.47	55.0	2.9	4,300	7.9	1,100	104	3.5
	"	12:00 N Oct. 5	-	15	4.93	48.6	2.3	2,300	7.5	800	82	3.2
	"	1:15 P Oct. 12	-	11	9.80	88.5	2.8	230	8.2	90	193	9.4
	"	3:25 P Oct. 25	-	9	12.51	108.1	6.0	36	8.0	55	238	12
	"	8:50 A Dec. 20	-	0	13.47	92.0	1.1	150	7.8	10	256	12

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
West Fork Blue	B - 192.1 W.F.B. - 1.1	[illegible] A Aug. 20	-	24	5.65	66.2	2.5	9,300	7.3	1,800	61	5.2
County bridge - above confluence	"	11:40 A Sept. 8	-	19	5.84	62.7	4.0	75,000	7.5	1,300	88	5.2
with Big Blue	"	10:40 A Sept.15	-	21	7.09	79.9	4.0	7,500	8.2	300	146	8.5
	"	11:00 A Sept.22	-	17	7.00	71.5	3.9	380	8.1	240	186	12
	"	11:30 A Sept.30	-	17	6.69	68.4	3.6	24,000	7.4	1,600	68	3.8
	"	12:55 P Oct. 12	-	16	11.11	107.2	6.0	430	8.3	190	209	13
	"	3:15 P Oct. 25	140	11	13.19	119.1	4.6	180	8.4	45	230	13
	"	[illegible] Dec. 20	-	0	16.29	111.1	1.3	230	8.1	15	219	16
West Fork Blue	B - 192.1 W.F.B. -24.8	12:45 P Aug. 19	-	24	5.66	66.4	2.7	43,000	7.7	2,800	63	3.3
County bridge - 2 miles below	"	4:30 P Sept.8	-	17	7.52	77.2	4.3	43,000	7.9	800	140	10
Beaver Crossing	"	1:15 P Sept.15	-	20	7.88	85.5	2.1	15,000	8.1	230	185	13
	"	3:00 P Sept.22	-	17	7.44	76.4	1.3	24,000	8.1	200	186	11
	"	2:00 P Sept.29	-	15	8.22	81.0	2.1	43,000	7.9	830	172	10
	"	3:35 P Oct. 4	-	14	8.86	86.3	1.6	11,000	8.2	170	201	13
	"	2:35 P Oct. 11	-	10	9.79	86.4	1.1	4,300	8.1	270	206	13
	"	12:40 P Oct. 18	-	7	9.70	79.8	2.5	430	7.9	80	214	15
	"	8:50 A Oct. 27	-	9	9.00	77.6	2.5	2,400	7.9	80	210	12
	"	8:40 A Dec. 7	-	0	12.45	85.0	2.2	910	7.6	20	210	13
West Fork Blue	B - 192.1 W.F.B.- 27.5	1:00 P Aug. 19	-	24	5.74	67.3	2.7	43,000	7.6	1,800	65	3.1
County bridge - east edge of	"	4:25 P Sept.8	-	17	7.84	78.4	1.8	150,000	8.2	180	233	7.0
Beaver Crossing	"	1:30 P Sept.15	-	20	7.62	83.1	2.1	9,100	8.2	280	184	14
	"	2:35 P Sept.22	-	18	7.51	78.7	1.9	15,000	8.1	500	174	11
	"	1:40 P Sept.29	-	16	8.14	81.6	2.7	43,000	8.0	800	168	10
	"	3:15 P Oct. 4	72	14	9.10	87.8	2.4	15,000	8.2	150	198	13
	"	2:10 P Oct. 11	70	11	10.00	90.4	1.9	4,300	8.2	120	201	16
	"	12:15 P Oct. 18	70	8	9.73	82.0	2.6	9,300	7.7	220	210	13
	"	9:20 A Oct. 27	60	9	9.17	79.1	2.8	910	7.9	160	210	14
	"	9:00 A Dec. 7	40	0	12.89	86.1	2.0	24,000	7.6	28	204	13
Beaver Creek	B - 192.1 W.F.B.-34.1	12:25 P Aug. 19	-	23	5.82	67.1	2.8	24,000	7.4	1,200	64	4.0
County bridge above confluence with	Bev.C.-1.5 "	3:45 P Sept.8	5	17	6.56	67.2	6.3	240,000	7.7	800	142	16
W.F.B.	"	12:45 P Sept.15	4	19	8.42	90.1	1.8	23,000	7.7	55	205	17
	"	2:10 P Sept.22	4	17	8.71	89.4	2.0	2,300	7.7	25	202	18
	"	1:10 P Sept.29	4	15	7.98	78.6	2.4	2,300	7.8	190	165	8.2
	"	2:45 P Oct. 4	4	14	10.45	100.8	2.3	4,300	7.7	55	225	16
	"	1:40 P Oct. 11	4	11	11.34	102.4	1.6	360	7.7	20	223	17
	"	11:45 A Oct. 18	4	8	10.02	84.7	3.7	930	7.3	15	228	16
	"	10:00 A Oct. 27	4	9	7.33	[illegible]	2.7	210	7.3	20	231	15
	"	9:30 A Dec. 7	4	0	10.67	72.6	1.9	<300	7.4	25	210	20
Beaver Creek	B - 192.1 W.F.B.-34.1	11:15 A Aug. 19	-	23	3.54	40.6	3.8	>1,100,000	7.7	800	84	7.5
County bridge - 3 miles below	Bev.C.-18.9 "	2:50 P Sept.8	-	17	6.75	69.3	>6.8	430,000	8.2	25	247	28
York	"	12:20 P Sept.15	-	20	0.00	0.0	19.6	230,000	7.7	120	317	29

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Beaver Creek County Bridge - 3 miles below York	B - 182.1 W.F.B.-34.1	3:50 P Sept.21	-	21	0.00	0.0	-	-	-	-	-	-
	Bev.C.-15.9 "	12:45 P Sept.25	-	17	0.00	0.0	24.6	2,400,000	7.7	45	375	34
	"	10:55 A Sept.28	-	13	2.52	23.8	-	-	-	-	-	-
	"	12:41 P Sept.29	-	14	2.50	28.0	7.2	75,000	7.8	25	307	37
	"	3:00 P Oct. 4	-	15	4.20	39.6	12.8	<3,600	8.1	55	301	32
	"	1:15 P Oct. 11	-	9	4.85	42.6	>53.3	2,100	7.8	35	296	52
	"	1:30 P Oct. 18	-	7	2.17	17.8	8.0	1,800	7.7	20	344	49
		10:20 A Oct. 27	-	9	0.00	0.0	16.1	2,400	7.5	25	321	46
Beaver Creek County Bridge - 2 miles below York	B - 182.1 W.F.B.-34.1	11:00 A Aug. 19	-	22	0.00	0.0	26.2	>11,000,000	7.3	500	132	14
	Bev.C.-17.4 "	2:35 P Sept.8	-	17	0.00	0.0	16.6	7,500,000	8.0	110	175	19
	"	12:00 N Sept.15	-	18	0.37	3.9	12.2	2,400,000	7.7	20	296	52
	"	11:45 A Sept.21	-	20	0.41	4.5	-	-	-	-	-	-
	"	12:30 P Sept.22	-	17	0.84	8.6	5.1	<36,000	8.1	25	308	26
	"	10:44 A Sept.28	-	13	0.85	8.0	-	-	-	-	-	-
	"	12:25 P Sept.29	-	13	0.00	0.0	102.2	15,000,000	7.3	85	341	37
	"	1:45 P Oct. 4	-	14	2.10	20.3	22.6	160,000	8.0	20	312	34
	"	1:00 P Oct. 11	-	9	1.73	14.9	36.4	43,000	8.1	15	314	33
	"	1:30 P Oct. 18	-	7	0.60	4.9	13.0	7,800	7.7	45	322	51
	"	10:40 A Oct. 27	-	9	0.00	0.0	28.6	7,500	7.9	160	324	37
Beaver Creek Bridge - U. S. Highway 81 at South part of York	B - 182.1 W.F.B.-34.1	10:50 A Aug.19	-	21	5.76	64.1	2.9	93,000	7.8	500	96	10
	Bev.C.-20.0 "	2:30 P Sept.8	1	16	7.85	78.9	6.1	43,000	8.1	85	191	29
	"	11:40 A Sept.15	1	17	8.07	82.9	3.7	43,000	8.0	20	216	19
	"	9:35 A Sept.21	1	14	7.32	70.6	-	-	-	-	-	-
	"	11:50 A Sept.22	1	16	7.40	74.4	3.2	23,000	7.9	65	231	15
	"	10:25 A Sept.28	1	11	9.00	81.2	-	-	-	-	-	-
	"	12:05 P Sept.29	-	12	9.59	88.6	2.8	24,000	8.1	15	236	16
	"	1:30 P Oct. 4	4	13	10.63	100.3	3.2	9,300	8.2	10	228	18
	"	12:40 P Oct. 11	1	10	9.97	87.9	4.4	2,300	8.0	10	234	21
	"	1:45 P Oct. 18	0.7	8	9.71	81.9	2.6	24,000	7.9	15	238	13
	"	10:55 A Oct. 27	0.7	9	7.03	60.7	2.2	9,300	7.9	15	244	20
	"	10:25 A Dec. 7	-	0	9.48	64.8	1.3	2,000	7.7	7	248	18
South Branch West Fork Blue 1 mile above confluence with W.F.B.	B - 182.1 W.F.B.-34.1	12:30 P Aug.19	66	24	6.07	72.[illegible]	2.2	15,000	7.7	1,400	63	3.6
	S.B.W.F.B. - 1.0	3:35 P Sept.8	50	19	8.21	87.5	2.0	24,000	8.2	220	175	12
	"	12:55 P Sept.15	48	19	8.04	86.0	1.8	24,000	8.2	210	174	12
	"	2:20 P Sept.22	50	17	7.64	78.4	1.4	3,900	8.0	550	175	12
	"	1:20 P Sept.29	43	15	8.43	83.1	2.0	4,300	7.8	600	168	11
	"	2:55 P Oct. 4	55	14	9.20	88.7	1.4	4,300	8.2	300	182	13
	"	1:50 A Oct. 11	50	11	10.19	92.0	1.4	360	8.1	70	193	13
	"	12:00 N Oct. 18	41	7	9.76	80.1	1.6	430	7.9	130	232	12
	"	9:45 A Oct. 27	41	9	9.22	79.6	1.8	430	7.9	70	212	16
	"	9:30 A Dec. 7	50	0	12.88	87.8	1.9	<300	7.8	20	201	14

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
South Branch West Fork Blue	B - 182.1 W.F.B.-34.1	8:15 A Aug.19	-	22	0.96	10.8	21.2	420,000	7.7	120	178	26
County Bridge - 4 miles east	S.B.W.F.B. - 72.5	8:35 A Sept. 15	-	17	1.77	18.2	19.1	420,000	7.9	90	222	44
of Hastings	"	9:00 A Sept.22	-	17	0.00	0.0	19.7	180,000	7.5	75	236	36
	"	9:40 A Sept.29	-	13	4.01	37.8	10.3	95,000	7.7	70	290	28
	"	11:10 A Oct. 4	-	14	6.00	57.9	>31.5	23,000	8.1	130	232	31
	"	10:30 A Oct. 11	-	8	5.47	46.3	17.2	98,000	7.7	45	241	29
	"	5:05 P Oct. 18	-	11	8.01	72.4	11.4	36,000	7.8	25	282	36
	"	1:40 P Oct. 27	-	13	7.19	67.8	12.6	110,000	7.9	35	276	46
South Branch West Fork Blue	B - 182.1 W.F.B.-34.1	8:00 A Aug.19	-	21	0.36	4.0	10.2	430,000	8.1	100	200	33
County Bridge - 3 miles east of	S.B.W.F.B. - 73.2	10:45 A Sept. 8	-	16	3.19	30.8	11.5	430,000	7.6	680	90	6.7
Hastings	"	8:25 A Sept. 15	-	17	1.49	15.3	8.9	91,000	7.7	50	214	21
	"	8:35 A Sept. 22	-	16	0.66	6.6	7.6	430,000	7.7	40	212	38
	"	9:30 A Sept.29	-	12	0.36	3.3	20.0	4,600,000	7.5	65	287	60
	"	11:00 A Oct. 4	-	16	3.40	32.8	>29.9	340,000	8.0	240	260	36
	"	10:15 A Oct. 11	-	8	3.80	32.1	25.3	930,000	7.8	30	229	39
	"	4:55 P Oct. 18	-	11	5.59	50.5	12.5	9,100	7.8	40	238	37
	"	1:25 P Oct. 27	-	12	4.67	43.1	15.4	46,000	7.7	25	271	57
	"	1:40 P Dec. 13	-	0	2.23	15.2	9.5	9,300	7.3	70	241	38
South Branch West Fork Blue	B - 182.1 W.F.B.-34.1	7:45 A Aug. 19	-	21	0.53	5.9	9.9	200,000	7.6	60	186	19
County Bridge - 2 miles west of	S.B.W.F.B. - 76.7	10:30 A Sept. 8	-	16	3.15	30.4	>13.3	230,000	7.5	500	85	3.3
Hastings	"	8:10 A Sept.15	-	17	0.65	6.5	9.0	150,000	7.5	46	201	25
	"	8:30 A Sept.22	-	16	7.89	79.3	1.1	15,000	8.1	35	182	9.0
	"	9:20 A Sept.29	-	10	9.70	85.6	2.5	9,300	8.1	150	168	13
	"	10:40 A Oct. 4	-	14	2.80	27.0	>13.8	>1,100,000	7.6	36	215	28
	"	10:00 A Oct. 11	-	10	2.86	25.4	19.5	930,000	7.8	16	213	35
	"	4:45 P Oct. 18	-	11	12.23	110.7	5.4	24,000	8.7	90	179	21
	"	1:15 P Oct. 27	-	12	14.25	131.6	3.4	910	8.5	30	181	11
South Branch West Fork Blue	B - 182.1 W.F.B.-34.1	7:30 A Aug. 19	-	21	1.79	19.9	6.8	43,000	7.6	240	52	1.8
County Bridge - 1 mile northeast of	S.B.W.F.B. - 78.6	11:10 A Sept. 8	-	15	5.32	52.4	8.7	460,000	7.1	1,000	32	1.0
Hastings	"	8:50 A Sept.15	0	17	3.42	35.1	6.5	<3,600	7.5	85	66	6.1
	"	9:00 A Sept.29	0	11	2.20	19.9	11.3	43,000	7.8	880	100	10
	"	10:20 A Oct. 4	-	14	8.60	84.0	>13.6	24,000	7.6	330	106	11
	"	9:45 A Oct. 11	-	4	6.65	50.6	21.2	9,300	7.3	330	116	12
Big Blue River	B - 184.2	9:25 A Aug. 20	-	24	6.46	75.7	3.7	93,000	7.2	1,400	42	0.9
County Bridge - 2 miles above	"	11:15 A Sept. 9	100	19	3.49	37.3	9.7	150,000	7.3	1,300	100	3.1
confluence with W.F.B.	"	10:25 A Sept.16	120	20	6.13	68.8	3.8	9,100	8.1	210	199	4.9
	"	10:35 A Sept.23	10	17	6.67	68.5	2.8	4,800	7.9	180	188	6.2
	"	12:25 P Sept.30	8	18	7.41	77.7	3.0	2,300	8.3	120	232	7.2
	"	11:30 A Oct. 5	-	13	9.11	86.9	2.4	4,300	8.2	190	179	11
	"	12:45 P Oct. 12	80	12	9.42	86.9	3.1	230	8.2	80	244	6.6
	"	3:10 P Oct. 25	11	10	11.04	97.4	6.1	36	8.0	60	278	7.0
	"	9:40 A Dec. 20	-	0	12.80	87.5	1.0	230	7.7	10	282	11

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Big Blue River Transmission line crosses Highway 1½ mile southeast of Milford	B - 202.0	9:45 A Aug. 20	-	24	5.35	62.7	2.6	43,000	7.2	1,300	44	1.3
	"	10:05 A Sept. 9	-	18	4.61	48.3	4.0	240,000	7.6	650	118	3.9
	"	10:10 A Sept.16	-	20	4.80	52.3	4.2	43,000	8.0	210	187	6.1
	"	10:10 A Sept.23	-	17	4.75	48.8	7.1	150,000	7.7	190	226	7.9
	"	11:35 A Sept.30	-	16	5.00	50.5	3.6	43,000	8.1	180	232	6.4
	"	11:10 A Oct. 5	-	14	6.41	61.8	4.7	1,500	8.2	170	241	6.9
	"	12:35 P Oct. 12	-	12	9.60	88.6	5.5	15,000	8.1	55	256	6.0
	"	3:30 P Oct. 25	-	11	9.21	83.2	8.4	750	7.9	90	280	7.1
	"	9:55 A Dec. 20	-	0	10.49	71.7	2.0	11,000	7.6	15	303	9.8
Big Blue River Bridge - U. S. Highway 46 - Milford	B - 204.4	10:05 A Aug. 20	-	23	4.86	56.0	3.2	24,000	7.2	1,300	47	3.6
	"	10:40 A Sept. 9	-	18	5.20	54.5	3.1	24,000	8.1	320	199	5.1
	"	9:55 A Sept.16	-	20	5.59	61.0	3.0	9,300	8.0	260	190	5.4
	"	9:50 A Sept.23	-	17	4.76	48.9	3.0	9,300	7.7	220	232	6.9
	"	11:15 A Sept.30	-	16	5.81	58.4	3.7	9,100	8.1	200	222	5.4
	"	11:00 A Oct. 5	-	13	8.42	79.4	4.6	4,300	8.2	160	256	6.6
	"	12:10 P Oct. 12	-	11	8.96	80.9	4.0	9,300	8.1	70	260	6.5
	"	3:40 P Oct. 25	6.5	10	12.46	109.7	9.7	430	8.0	80	292	5.9
	"	10:10 A Dec. 20	-	0	12.12	82.9	1.1	4,600	7.8	15	298	9.5
Big Blue River County Bridge - 1 mile south of Seward	B - 221.7	10:30 A Aug. 20	-	23	5.33	61.4	4.4	240,000	7.1	1,300	64	3.4
	"	10:10 A Sept. 9	-	16	6.57	66.0	4.0	1,100,000	7.8	450	159	4.0
	"	9:30 A Sept.16	-	19	5.52	59.0	>5.5	240,000	8.1	340	225	6.6
	"	9:15 A Sept.23	-	16	7.19	72.5	3.0	3,600	8.1	260	252	6.7
	"	10:00 A Sept.30	22	15	8.66	81.7	2.8	4,300	8.2	210	256	6.1
	"	10:10 A Oct. 5	-	11	9.01	81.5	3.1	2,300	8.3	160	256	6.6
	"	11:15 A Oct. 12	-	8	10.89	91.4	2.6	4,300	8.2	95	259	5.6
	"	2:10 P Oct. 25	16	9	9.91	85.6	6.1	4,300	7.6	40	292	6.1
	"	10:40 A Dec. 20	20	0	10.39	71.0	0.8	91	7.7	15	351	8.2
Big Blue River Along Highway below confluence of Plum Creek	B - 223.0	11:00 A Aug. 20	-	24	5.43	63.7	3.8	93,000	7.7	1,300	60	2.3
	"	9:55 A Sept. 9	-	16	7.23	72.7	2.5	43,000	8.0	450	166	5.9
	"	9:15 A Sept.16	-	19	6.97	74.5	2.9	9,100	8.3	310	225	6.3
	"	10:15 A Sept.30	22	13	7.46	70.4	4.7	240,000	8.2	210	257	6.1
	"	10:30 A Oct. 5	-	11	8.15	73.6	4.2	240,000	8.3	110	256	7.0
	"	11:35 A Oct. 12	-	9	9.33	80.5	9.0	1,100,000	8.1	85	254	5.4
	"	2:30 P Oct. 25	15	9	7.31	63.1	>7.3	460,000	7.6	45	284	10
	"	11:00 A Dec. 20	27	0	12.39	84.6	3.3	24,000	7.5	15	294	9.4
Plum Creek												
County Bridge - 1/2 mile southeast of Seward	B - 223.4 Pl.C. - 0.2	10:30 A Aug. 20	9	24	5.42	63.5	3.0	9,300	7.9	230	139	1.5
	"	9:40 A Sept. 9	2	15	7.24	71.3	3.4	240,000	7.5	700	92	1.6
	"	9:00 A Sept.16	0.2	18	6.31	66.1	3.0	4,300	8.0	130	183	3.5
	"	9:05 A Sept.23	0.5	16	6.09	61.2	>6.1	2,300	7.7	45	240	6.5
	"	9:45 A Sept.30	0.2	12	6.89	63.6	3.9	4,300	7.9	650	110	3.1
		9:55 A Oct. 5	0.2	11	7.71	69.6	5.9	360	7.9	290	142	5.0

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Plum Creek	B - 223.4 Pl.C. - 0.2	11:00 A Oct. 12	0.2	9	9.14	78.9	4.4	230	7.6	110	169	4.0
County Bridge - 1/2 mile southeast	"	2:00 P Oct. 25	0.2	11	4.45	40.2	>12.4	<30	7.5	35	311	10
of Seward	"	10:50 A Dec. 20	1.6	0	12.84	88.4	1.0	280	7.7	16	284	9.0
Big Blue River	B - 225.4	11:15 A Aug. 20	-	24	5.23	61.3	2.5	43,000	7.3	1,300	63	0.9
Bridge west of Seward - U. S.	"	9:15 A Sept. 9	-	16	6.79	68.2	2.7	23,000	8.0	390	169	4.0
Highway 34	"	8:40 A Sept.16	-	19	6.82	72.9	3.1	2,300	8.2	310	222	6.4
	"	8:45 A Sept.23	-	16	6.80	68.3	2.6	4,300	8.1	270	249	5.4
	"	9:35 A Sept.30	-	13	8.24	77.7	2.5	910	8.3	210	256	5.3
	"	9:40 A Oct. 5	-	11	8.89	80.2	3.2	2,400	8.2	170	262	6.1
	"	10:45 A Oct. 12	-	9	10.43	90.2	2.6	430	8.2	75	259	5.2
	"	1:25 P Oct. 25	-	9	8.89	76.7	7.6	230	7.7	40	294	6.2
	"	11:35 P Dec. 20	-	0	9.30	63.6	6.6	230	7.8	1,000	282	8.9
Lincoln Creek	B - 225.5 Li.C. - 0.7	11:35 A Aug. 20	35	24	5.74	67.3	2.7	43,000	7.4	1,400	60	1.4
Bridge above confluence with	"	8:20 A Sept. 9	15	16	7.80	76.8	2.5	23,000	8.3	390	214	5.9
Big Blue	"	8:15 A Sept.16	12	18	7.00	73.4	2.8	4,300	8.3	300	225	6.3
	"	8:15 A Sept.23	10	16	7.31	73.6	2.1	2,300	8.1	240	243	6.0
	"	9:05 A Sept.30	8	12	8.64	79.8	2.1	930	8.3	170	244	5.3
	"	9:15 A Oct. 5	8	11	9.01	81.3	2.2	2,400	8.3	110	246	6.3
	"	10:25 A Oct. 12	10	9	10.40	89.8	2.0	390	8.3	50	247	5.6
	"	1:00 P Oct. 25	10	9	9.06	78.3	6.5	230	7.8	35	278	5.0
	"	11:45 A Dec. 20	14	0	13.15	89.8	0.8	430	7.8	20	262	8.0
Lincoln Creek	B - 225.5 Li.C. - 36.4	11:40 A Aug. 19	2.0	23	5.49	63.2	3.0	460,000	7.5	1,200	64	2.5
Bridge - U. S. Highway No. 81 -	"	2:00 P Sept.8	1.8	18	8.17	85.6	2.3	23,000	8.3	100	174	10
3 miles north of York	"	11:25 A Sept.15	2.0	18	7.55	79.1	2.4	4,300	8.2	70	185	11
	"	11:00 A Sept.22	1.5	17	6.62	68.0	2.0	4,300	8.1	70	211	11
	"	11:50 A Sept.29	1.5	14	9.70	93.5	3.6	2,300	8.2	45	216	12
	"	12:55 P Oct. 4	1.5	14	10.03	96.7	2.2	910	8.3	45	218	13
	"	12:15 P Oct. 11	1.5	8	10.80	91.0	2.2	430	8.3	15	225	13
	"	2:15 P Oct. 18	4.0	7	8.91	73.4	8.6	230	7.7	15	235	14
	"	11:30 A Oct. 27	1.4	9	5.15	44.5	7.7	91	8.0	25	248	14
	"	11:20 A Dec. 13	-	1	7.89	55.4	0.8	91	7.4	4	234	14
Lincoln Creek	B - 225.5 Li.C. - 62.2	10:10 A Aug. 19	1.0	22	3.07	34.8	6.0	43,000	7.4	400	68	7.0
Bridge - 3 miles east and 1 mile	"	1:20 P Sept.8	0.9	17	6.39	65.6	>6.4	15,000	8.1	65	196	23
north of Aurora	"	10:50 A Sept.15	1.0	18	4.35	45.6	5.1	24,000	8.1	55	208	26
	"	10:25 A Sept.22	0.5	17	5.25	53.9	8.3	2,300	7.9	120	245	32
	"	11:00 A Sept.29	0.5	11	8.08	72.9	9.4	430	8.1	100	232	34
	"	12:15 P Oct. 4	0.5	13	5.62	53.0	19.6	2,400	7.9	80	248	33
	"	11:45 A Oct. 11	0.6	7	5.37	44.2	12.0	750	7.7	35	247	34
	"	12:05 P Oct. 27	0.5	9	0.00	0.0	32.7	2,400	7.3	60	284	41

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Lincoln Creek	B - 225.5 Li.C. - 64.7	10:00 A Aug. 19	1.0	22	2.19	24.7	5.8	150,000	7.7	310	89	8.7
Bridge - U. S. Highway 34,	"	1:05 P Sept. 8	0.8	18	5.93	62.2	>5.9	23,000	8.1	100	230	26
1½ miles east of Aurora	"	10:40 A Sept.15	0.9	19	4.18	44.7	11.5	93,000	8.1	65	235	33
	"	10:45 A Sept.29	0.4	13	4.45	42.0	9.8	<3,600	8.1	55	253	31
	"	11:30 A Oct. 11	0.4	9	6.15	53.2	27.7	910	8.0	60	246	31
	"	3:00 P Oct. 18	0.4	8	5.30	44.7	6.5	430	7.9	35	263	37
	"	12:20 P Oct. 27	0.4	9	0.00	0.0	>27.5	>110,000	7.4	45	288	30
Lincoln Creek	B - 225.5 Li.C. - 67.7	9:50 A Aug. 19	0.8	22	5.13	58.1	3.9	43,000	7.7	290	52	1.3
Bridge - State Highway 14,	"	12:30 P Sept. 8	0.7	18	4.49	45.1	10.3	460,000	7.7	500	46	3.3
north of Aurora	"	10:25 A Sept.15	0.8	19	4.46	47.7	>13.8	3,600	8.1	15	264	25
Big Blue River	B - 227.7	11:55 A Aug. 20	-	24	5.15	60.4	2.9	120,000	7.2	1,400	70	1.2
County Bridge - 1 mile northwest	"	8:35 A Sept. 9	-	15	6.31	62.2	3.2	43,000	7.7	400	141	5.0
of Seward	"	8:25 A Sept.16	-	18	6.38	66.9	3.5	3,000	8.1	250	220	5.6
	"	8:30 A Sept.23	-	16	5.69	57.2	3.7	2,300	8.1	270	260	5.0
	"	9:20 A Sept.30	-	12	7.63	70.5	4.4	4,300	8.3	290	261	5.3
	"	9:25 A Oct. 5	-	11	8.21	74.1	2.7	4,300	8.2	200	268	6.6
	"	10:35 A Oct. 12	-	9	9.57	82.6	3.7	430	8.2	290	276	5.5
	"	1:10 P Oct. 25	5	9	8.09	69.8	>8.1	<300	7.7	50	316	6.0
North Branch Blue	B - 227.7 N.B.B. - 22.2	1:45 P Sept.7	-	-	5.66	-	4.0	2,300	7.9	45	200	6.9
Bridge below confluence with	"	9:45 A Sept.14	-	18	6.17	64.7	3.3	1,500	8.0	35	253	8.6
Davis Creek - 2 miles east and 2 miles	"	9:15 A Sept.21	-	17	4.75	48.8	3.1	930	8.2	50	256	10
south of Osceola	"	9:08 A Sept.23	-	12	6.82	62.9	2.3	1,500	8.1	20	270	8.4
	"	1:05 P Oct. 7	-	8	7.46	62.8	2.4	430	8.0	15	273	8.0
	"	2:35 P Oct. 14	-	10	9.45	83.4	2.4	430	8.2	25	282	7.5
	"	11:30 A Oct. 25	-	8	6.14	51.8	>6.1	930	7.4	25	292	9.9
	"	9:45 A Dec. 13	-	0	8.05	55.0	1.2	43	7.8	10	304	11
Davis Creek	B - 227.7 N.B.B.-22.2	1:50 P Sept.7	-	-	5.08	-	5.1	93,000	8.1	130	260	41
County Bridge - 2 miles southeast	Da.C.-1.5 "	9:55 A Sept.14	-	16	5.29	53.2	10.7	9,100	8.3	110	298	32
of Osceola	"	9:35 A Sept.21	-	17	0.91	9.34	8.7	24,000	8.1	170	347	36
	"	9:30 A Sept.28	-	11	5.82	52.5	3.9	4,300	8.3	35	329	30
	"	12:55 P Oct. 7	-	7	7.38	60.6	6.2	2,300	8.2	30	290	30
North Branch Blue	B - 227.7 N.B.B.-23.9	1:25 P Sept.7	-	-	4.83	-	2.9	2,300	8.0	140	244	8.3
Bridge above confluence with	"	9:25 A Sept.14	-	18	4.28	44.9	3.2	430	8.2	130	248	8.7
Davis Creek - 2½ miles east	"	8:50 A Sept.21	-	17	4.27	43.8	2.6	2,400	8.3	80	266	11
of Stromsburg	"	8:45 A Sept.28	-	12	6.30	58.2	2.7	11,000	7.7	60	267	10
	"	1:25 P Oct. 7	-	7	11.10	91.2	3.2	2,400	8.2	25	254	8.9
	"	2:45 P Oct. 14	-	11	13.19	119.1	3.0	230	8.2	45	267	8.7
	"	11:45 A Oct. 25	-	8	6.78	57.2	5.1	91	7.4	20	296	14

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
North Branch Blue Bridge - 7 miles southwest of Stromsburg	B - 227.7 N.B.B.-27.9	1:06 P Sept.7	-	-	4.84	-	3.2	4,300	8.0	90	285	6.4
	"	9:06 A Sept.14	-	16	3.84	38.6	2.6	930	8.0	20	267	9.4
	"	8:25 A Sept.21	-	16	2.17	21.8	3.8	2,300	8.3	15	282	10
	"	8:30 A Sept.28	-	11	4.30	38.8	3.2	930	8.0	15	279	10
	"	1:35 P Oct. 7	-	8	5.99	50.5	3.4	2,400	7.9	20	279	11
	"	3:00 P Oct. 14	-	10	7.07	62.3	4.1	430	8.2	20	286	9.0
	"	12:00 N Oct. 25	-	8	2.37	20.0	7.0	4,600	7.5	20	312	11
	"	10:25 A Dec. 13	-	0	6.64	45.4	2.6	11,000	7.6	15	302	13
North Branch Blue Bridge - U. S. Highway #81 - South of Stromsburg	B - 227.7 N.B.B.-29.7	12:45 P Sept.7	-	-	5.48	-	3.4	2,300	8.0	20	261	13
	"	8:45 A Sept.14	-	17	4.76	48.9	1.9	4,300	8.2	100	269	5.6
	"	8:00 A Sept.21	-	17	3.22	33.1	1.7	4,300	8.3	60	275	6.9
	"	8:08 A Sept.28	-	11	6.47	58.4	2.0	910	8.2	35	275	6.8
	"	2:00 P Oct. 7	0.4	8	9.91	83.5	2.4	430	7.9	56	274	6.4
	"	3:10 P Oct. 14	-	11	12.27	110.8	3.4	1,500	8.3	20	278	6.0
	"	12:10 P Oct. 25	-	8	5.13	43.3	2.7	140	7.9	16	313	7.2
	"	10:45 A Dec. 13	-	0	9.49	64.8	2.0	150	7.8	120	299	8.7

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River Bridge - U. S. Highway 24 and 40	R - 0.2 L	Mar. 8	900	0	13.05	89.3	3.4	4,300	8.3	1,100	166	14
	" R			0	12.85	88.0		3,900				
	" L	Mar. 15	580	0	12.75	87.2	2.8	9,300	8.4	500	197	24
	" R			0	12.55	85.9		9,300				
	" L	Mar. 1	1,200	7	10.45	86.1	2.0	7,500	8.3	1,000	190	26
	" R			7	10.50	86.4		15,000				
	" L	Mar. 14	830	10	9.80	86.2	2.8	4,300	8.4	500	249	27
	" R			10	9.70	85.5		9,300				
	" L	8:35 A Mar. 30	720	16	8.05	81.0	4.6	43,000	8.3	360	247	31
	" R			16	8.20	82.5		23,000				
	" L	9:00 A May 21	630	21	7.70	85.7	5.0	15,000	8.3	180	233	35
	" R			21	7.90	87.9		23,000				
	" L	9:00 A July 9	2,500	25	6.70	80.0	2.6	93,000	8.2	3,000	133	11
	" R			25	6.75	80.5		93,000				
	" L	8:00 A Aug. 6	1,200	21	7.30	81.3	3.8	230,000	8.2	7,400	141	11
	" R			21	7.35	81.9		23,000				
	" L	7:45 A Sept. 3	700	22	7.25	82.0	3.4	43,000	8.5	450	241	36
	" R			22	7.40	83.9		93,000				
	" L	8:30 A Sept.30	350	13	8.70	82.1	3.6	93,000	8.4	550	260	31
	" R			13	8.15	76.9		43,000				
	" L	8:30 A Nov. 5	175	9	9.30	80.3	5.3	23,000	8.3	260	238	32
	" R			9	9.05	78.1		43,000				
	" L	8:40 A Dec. 14	460	2	12.25	88.5	3.4	93,000	8.3	850	246	31
	" R			2	12.20	88.1		23,000				
Republican River Bridge - U.S. Highway No. 77 - North of Junction City	R - 6.9	Mar. 8	900	0	13.05	89.3	1.8	4,300	8.3	1,000	172	15
	"	Mar. 15	580	0	12.50	85.6	2.0	910	8.4	400	209	26
	"	Apr. 1	1,200	6	10.50	84.2	2.0	4,300	8.3	1,000	195	25
	"	Apr. 14	825	10	9.80	86.4	1.9	4,300	8.4	500	247	30
	"	7:45 A Apr. 30	720	16	8.35	84.0	2.7	1,500	8.3	340	251	31
	"	7:45 A May 21	625	21	7.70	85.7	4.8	4,300	8.3	170	237	36
	"	6:25 A June 3	630	20	6.88	75.2	3.8	-	8.4	1,300	215	23
	"	6:15 A June 10	700	22	7.01	79.5	3.2	-	8.0	2,400	176	14
	"	3:30 [illegible] June 16	1,500	26	5.30	64.6	4.8	-	7.6	4,500	167	13
	"	4:35 A June 24	1,480	21	6.56	73.0	3.1	-	7.8	13,000	144	9.3
	"	6:00 A July 1	10,000	22	5.98	67.7	3.3	-	7.7	11,000	115	3.7
	"	7:45 A July 9	2,200	25	7.10	84.7	2.7	24,000	8.1	2,900	134	13
	"	5:25 A July 9	2,200	26	6.32	76.9	2.1	-	7.9	3,200	147	9.2
	"	7:00 A Aug. 6	1,185	21	7.60	84.6	4.4	43,000	8.3	7,300	139	12
	"	7:00 A Sept.3	700	22	7.60	86.0	2.3	9,300	8.4	450	242	41
	"	7:30 A Sept.30	300	13	9.00	85.0	2.6	43,000	8.4	500	259	36
	"	7:30 A Nov. 5	175	9	9.50	82.0	3.8	15,000	8.3	280	237	36
	"	8:00 A Dec.14	440	2	12.20	88.1	3.2	23,000	8.3	800	248	34

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 18.6	5:30 A Apr. 14	810	10	9.62	84.8	1.9	3,900	8.4	550	251	20
Bridge at Milford	"	5:14 P Apr. 22	750	20	8.31	90.7	3.6	9,300	8.5	550	241	22
	"	6:05 A May 12	680	13	9.70	91.5	3.8	24,000	8.2	400	232	26
	"	6:50 A June 3	630	21	7.34	81.6	3.6	-	8.1	1,400	215	40
	"	6:50 A June 10	695	23	7.00	80.7	2.8	-	8.0	3,500	207	28
	"	3:50 A June 16	1,500	25	4.73	56.5	4.2	-	7.5	4,900	116	8.4
	"	4:55 A June 24	1,500	21	6.72	74.8	2.9	-	7.9	13,600	144	8.9
	"	6:20 A July 1	10,800	22	6.43	72.7	3.1	-	7.6	10,000	91	3.5
	"	5:50 A July 9	1,500	25	7.00	83.6	2.3	-	8.0	3,500	152	6.0
	"	5:10 A July 16	2,300	25	7.11	84.9	2.0	-	8.0	2,600	164	15
	"	5:35 A July 22	6,200	24	5.77	67.7	3.4	-	7.7	4,600	99	5.3
	"	9:15 A Aug. 5	1,370	22	7.65	86.7	3.7	46,000	7.9	8,000	144	12
	"	5:20 A Aug. 13	690	25	6.88	82.1	1.6	4,300	8.5	1,700	209	27
	"	7:30 A Aug. 25	670	22	7.16	81.1	3.4	9,300	8.4	3,800	174	20
	"	6:30 A Sept. 8	500	18	8.38	87.9	3.5	24,000	8.1	3,800	172	20
	"	7:25 A Sept.23	200	18	8.21	86.2	4.4	9,300	8.7	500	262	40
	"	6:10 A Oct. 5	150	11	9.10	82.1	4.0	15,000	8.6	300	266	55
	"	7:15 A Oct. 28	140	9	9.72	83.8	4.3	1,500	8.5	100	270	48
	"	6:40 A Dec. 16	450	0	13.54	92.6	3.9	15,000	8.4	900	253	33
Republican River	R - 25.7	9:17 A Apr. 1	1,170	8	10.69	90.2	2.2	9,300	8.2	1,000	197	20
Bridge east of Wakefield	"	6:00 A Apr. 14	800	10	9.85	86.8	2.4	9,300	8.4	450	250	21
	"	4:53 P Apr. 22	740	20	8.61	93.8	3.3	9,300	8.5	550	241	23
	"	6:35 A May 12	680	13	9.51	89.7	3.8	24,000	8.2	400	228	26
	"	7:35 A June 3	650	20	7.35	80.2	3.6	-	7.9	1,300	210	30
	"	7:30 A June 10	690	24	7.03	82.4	2.5	-	8.0	3,200	152	9.6
	"	4:20 P June 16	1,100	25	3.15	37.6	2.7	-	7.6	5,500	122	8.4
	"	5:25 A June 24	1,500	21	6.86	76.3	3.6	-	7.9	12,000	148	11
	"	6:50 A July 1	11,200	23	6.34	73.0	3.4	-	7.9	12,000	140	4.2
	"	6:30 A July 9	1,300	24	6.77	79.4	2.2	-	8.0	3,200	149	7.6
	"	5:45 A July 16	1,700	25	6.34	75.7	1.6	-	8.1	2,800	168	29
	"	6:05 A July 22	4,950	24	5.51	64.7	3.8	-	7.7	4,700	84	3.4
	"	9:45 A Aug. 5	1,285	22	7.55	85.7	3.8	24,000	7.9	9,000	140	12
	"	5:50 A Aug. 13	620	24	6.80	79.7	1.8	46,000	8.6	1,500	213	28
	"	8:00 A Aug. 25	600	23	7.38	85.1	2.4	46,000	8.4	3,600	177	24
	"	7:00 A Sept. 8	360	18	8.37	87.8	3.0	46,000	8.1	2,800	176	24
	"	7:50 A Sept. 23	190	17	8.34	85.6	4.5	24,000	8.7	550	258	39
	"	6:35 A Oct. 5	145	11	9.31	84.1	4.2	11,000	8.6	280	278	53
	"	7:40 A Oct. 28	135	9	9.68	83.5	4.5	4,600	8.4	100	265	40
	"	7:05 A Dec. 16	445	0	-	-	3.0	46,000	8.3	1,100	246	25
Republican River	R - 35.9	9:54 A Apr. 1	1,150	9	10.54	91.0	2.7	24,000	8.2	1,100	201	21
No bridge - Broughton	"	4:25 P Apr. 22	790	20	8.41	91.7	3.3	24,000	8.4	400	240	23
	"	7:10 A May 12	720	12	9.56	88.3	4.1	24,000	8.2	450	252	22
	"	8:05 A June 3	720	21	7.47	83.2	3.9	-	8.[illegible]	1,000	210	27
	"	8:05 A June 10	685	23	6.94	79.9	2.9	-	8.0	3,100	144	9.6

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 35.9	4:50 P June 16	1,150	26	5.08	61.8	4.5	-	7.7	4,600	94	11
No bridge - Broughton	"	6:00 A June 24	1,520	21	6.99	77.8	4.2	-	7.7	24,000	144	8.8
	"	7:20 A July 1	10,700	23	6.70	77.3	3.6	-	7.9	11,000	109	2.4
	"	7:05 A July 9	1,400	25	6.76	80.8	2.0	-	8.1	3,000	155	8.4
	"	6:25 A July 16	1,800	25	6.77	80.9	2.2	-	8.1	3,200	164	24
	"	6:50 A July 22	4,800	23	5.63	64.9	3.5	-	7.7	4,100	100	4.8
	"	10:20 A Aug. 5	1,235	22	7.35	83.2	3.5	46,000	8.0	8,600	157	11
	"	6:35 A Aug. 13	610	24	7.09	83.1	1.8	24,000	8.5	1,400	220	29
	"	8:30 A Aug. 25	600	23	7.20	83.0	2.0	46,000	8.3	3,400	180	21
	"	7:35 A Sept.8	340	18	8.32	87.3	2.6	46,000	8.2	2,500	180	25
	"	8:20 A Sept.23	170	17	8.30	85.3	4.7	9,300	8.5	500	257	45
	"	7:05 A Oct. 5	140	11	9.13	82.4	4.2	24,000	8.6	240	280	64
	"	8:05 A Oct. 28	135	9	9.52	82.3	4.7	46,000	8.4	110	260	48
	"	7:15 A Nov. 8	335	7	10.70	88.0	>7.7	430,000	8.2	1,700	177	20
	"	7:00 A Nov. 10	315	3	12.06	89.5	4.8	21,000	8.2	1,200	209	37
	"	6:45 A Nov. 12	300	4	11.45	87.2	4.7	43,000	8.3	1,200	220	34
	"	7:20 A Nov. 15	295	5	11.12	86.9	2.9	9,300	8.2	1,000	238	24
	"	7:00 A Nov. 17	300	5	10.59	82.7	4.2	93,000	8.2	2,500	238	20
	"	7:00 A Nov. 22	270	0	13.07	89.3	2.4	24,000	8.2	600	244	29
	"	6:55 A Nov. 24	255	2	11.98	86.5	2.7	24,000	8.2	450	245	45
	"	7:50 A Dec. 16	445	0	13.16	89.9	3.2	9,300	8.1	1,200	244	34
Republican River	R - 42.1	8:37 A Apr. 1	1,190	8	10.73	90.6	2.1	2,400	8.2	900	202	24
State Highway #15 Clay Center	"	6:55 A Apr. 14	786	11	9.93	89.6	2.2	2,400	8.4	500	245	21
	"	3:57 P Apr. 22	708	20	8.58	93.5	5.4	2,400	8.4	450	238	23
	"	8:15 A May 12	766	12	9.94	91.8	4.3	1,500	8.3	450	210	20
	"	8:25 A June 3	560	21	7.51	83.6	4.0	-	7.9	1,300	211	27
	"	8:25 A June 10	682	24	7.15	83.8	2.9	-	8.1	3,200	162	19
	"	5:15 P June 16	1,270	26	5.15	62.7	4.8	-	7.7	3,100	136	18
	"	6:25 A June 24	1,540	21	7.10	79.1	3.8	-	7.8	13,500	138	10
	"	7:45 A July 1	10,200	23	6.10	70.3	3.2	-	7.7	11,000	110	2.5
	"	8:00 A July 9	1,890	24	7.02	82.4	2.3	-	8.1	2,900	152	7.2
	"	7:15 A July 16	2,300	25	6.89	82.2	1.9	-	8.2	3,600	155	22
	"	7:15 A July 22	4,250	24	5.63	66.1	3.7	-	7.7	4,600	90	4.9
	"	10:45 A Aug. 5	1,150	22	7.50	84.9	3.7	110,000	7.9	9,000	116	12
	"	7:10 A Aug. 13	598	24	7.17	84.1	2.0	24,000	8.5	1,400	219	29
	"	9:00 A Aug. 25	565	24	7.38	86.6	1.9	9,300	8.4	3,700	168	20
	"	8:05 A Sept.8	313	17	8.55	87.8	2.3	9,300	8.3	2,500	179	26
	"	8:50 A Sept.23	165	18	8.62	90.4	4.4	4,300	8.6	500	256	45
	"	7:30 A Oct. 5	135	11	9.42	85.1	4.5	2,400	8.6	240	272	61
	"	8:30 A Oct. 28	127	9	10.19	87.9	4.9	2,400	8.4	130	272	32
	"	7:50 A Nov. 8	325	5	10.99	85.8	7.0	93,000	8.2	1,400	192	29
	"	7:30 A Nov. 10	305	2	12.19	88.0	4.5	43,000	8.3	1,100	208	37
	"	7:15 A Nov. 12	289	4	11.77	89.5	4.5	24,000	8.3	1,100	223	32
	"	7:45 A Nov. 15	285	5	11.21	87.6	3.6	9,300	8.2	1,000	242	28
	"	7:25 A Nov. 17	290	5	10.81	84.5	3.9	24,000	8.3	2,200	237	21

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 42.1	7:35 A Nov. 22	254	0	13.11	89.6	2.2	24,000	8.3	600	244	30
State Highway #15 Clay Center	"	7:15 A Nov. 24	245	2	12.12	87.6	2.8	15,000	8.2	500	244	47
	"	8:15 A Dec. 16	445	-1	13.63	93.2	3.1	11,000	8.2	1,100	240	32
Republican River	R - 46.4	10:40 A Apr. 1	1,190	9	10.63	91.9	2.1	7,500	8.2	1,000	203	22
Bridge West of Clay Center - U. S. Highway No. 24	"	7:35 A Apr. 14	785	11	9.64	87.1	1.8	9,300	8.4	500	247	21
	"	3:30 P Apr. 22	708	20	8.41	91.7	3.2	360	8.3	500	234	23
	"	8:35 A May 12	766	12	9.61	90.6	4.2	15,000	8.2	650	225	21
	"	8:40 A June 3	550	21	7.31	81.3	3.9	-	7.9	800	235	17
	"	8:50 A June 10	660	24	6.95	81.5	4.0	-	8.0	3,800	173	5.2
	"	5:30 P June 16	1,270	26	4.68	56.9	4.3	-	7.7	4,200	132	34
	"	7:20 A June 24	1,560	22	7.28	82.5	4.3	-	7.9	15,000	145	11
	"	8:20 A July 1	9,710	24	6.24	73.2	3.4	-	7.7	11,000	116	2.8
	"	8:20 A July 9	1,890	23	6.62	76.2	1.9	-	8.2	2,800	154	8.0
	"	7:40 A July 16	2,200	25	6.67	79.6	2.6	-	8.2	4,800	153	24
	"	7:50 A July 22	4,280	24	5.78	67.8	3.2	-	7.7	4,400	91	5.5
	"	11:15 A Aug. 5	1,150	23	7.32	84.4	4.0	21,000	7.8	7,000	138	13
	"	7:35 A Aug. 13	600	24	6.84	80.2	2.1	4,300	8.6	1,400	221	29
	"	9:30 A Aug. 25	545	23	7.12	82.1	2.6	4,300	8.5	3,400	170	20
	"	8:40 A Sept. 8	310	17	8.36	85.9	2.1	46,000	8.1	2,400	174	28
	"	9:10 A Sept. 23	165	18	8.42	88.3	4.3	4,300	8.6	500	255	43
	"	8:00 A Oct. 5	135	13	9.51	89.7	3.8	<300	8.6	260	274	61
	"	8:50 A Oct. 28	127	10	10.02	88.4	3.9	430	8.5	130	232	36
	"	8:20 A Nov. 8	325	5	11.20	87.5	7.3	23,000	8.3	1,300	198	35
	"	7:55 A Nov. 10	305	2	12.29	88.7	4.3	43,000	8.2	1,200	207	36
	"	7:45 A Nov. 12	289	4	11.80	89.8	3.6	24,000	8.3	1,100	224	31
	"	8:15 A Nov. 15	285	5	11.25	87.9	2.9	43,000	8.3	1,000	239	28
	"	7:40 A Nov. 17	290	5	10.78	84.2	4.2	9,300	8.3	2,000	236	23
	"	7:55 A Nov. 22	254	0	13.12	89.7	1.9	2,300	8.2	550	242	34
	"	7:35 A Nov. 24	245	2	12.39	89.4	3.2	15,000	8.3	500	246	51
	"	8:30 A Dec. 16	445	0	13.70	93.6	3.6	4,300	8.1	1,100	240	41
Republican River	R - 57.5	11:08 A Apr. 1	1,210	9	10.84	93.7	1.1	15,000	8.2	1,000	204	22
Bridge on Highway 80, Southwest of Morganville	"	8:15 A Apr. 14	790	11	9.99	90.3	2.4	2,300	8.4	500	246	20
	"	3:02 P Apr. 22	700	19	8.59	91.8	4.1	750	8.3	500	235	24
	"	9:00 A May 12	730	13	9.63	90.7	4.2	9,300	8.2	450	228	22
	"	9:05A June 3	550	21	7.73	86.0	3.9	-	8.1	1,000	218	26
	"	9:15 A June 10	650	24	7.03	82.4	2.8	-	8.0	3,700	160	24
	"	5:55 P June 16	1,100	26	4.71	57.3	4.3	-	7.6	3,900	119	20
	"	7:40 A June 24	1,700	21	7.00	77.9	4.0	-	7.7	14,000	149	9.6
	"	8:50 A July 1	9,000	24	6.47	75.9	3.4	-	7.7	10,000	115	2.8
	"	8:45 A July 9	2,100	23	6.76	77.9	2.3	-	8.1	2,600	156	11
	"	8:10 A July 16	2,100	25	6.67	79.6	2.5	-	8.1	5,600	148	21
	"	8:35 A July 22	4,100	24	5.87	68.9	3.8	-	7.7	4,000	92	4.6
	"	11:40 A Aug. 5	1,170	23	7.38	85.3	3.8	46,000	7.9	8,600	138	12

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River Bridge on Highway 80, Southwest of Morganville	R - 97.5	8:25 A Aug. 13	650	24	7.10	83.2	2.4	24,000	8.6	1,300	220	32
	"	10:00 A Aug. 25	550	24	7.33	85.9	3.0	24,000	8.4	2,800	174	23
	"	9:20 A Sept. 8	380	18	8.39	88.0	2.6	24,000	8.1	2,200	172	26
	"	9:35 A Sept.23	162	18	8.31	87.3	3.9	4,600	8.6	450	258	51
	"	8:35 A Oct. 5	125	12	9.39	86.6	4.6	24,000	8.6	330	266	67
	"	9:15 A Oct. 28	130	10	10.30	90.8	5.7	4,300	8.5	180	255	32
	"	8:50 A Nov. 8	325	5	11.13	87.0	6.3	93,000	8.3	1,200	212	59
	"	8:20 A Nov. 10	306	3	12.22	90.8	3.9	43,000	8.2	1,300	205	37
	"	8:10 A Nov. 12	290	3	11.71	87.0	4.2	24,000	8.3	2,200	288	30
	"	8:40 A Nov. 15	290	5	11.11	86.8	4.2	24,000	8.2	2,000	238	23
	"	8:15 A Nov. 17	295	5	10.88	85.0	3.7	9,300	8.3	1,600	234	24
	"	8:25 A Nov. 22	254	0	13.21	90.3	2.2	15,000	8.3	550	245	49
	"	8:00 A Nov. 24	245	2	12.65	91.4	2.8	24,000	8.3	550	239	45
	"	8:50 A Dec. 16	440	0	13.31	91.0	2.6	110,000	8.3	1,200	234	22
Republican River County Bridge at Clifton	R - 69.5	11:35 A Apr. 1	1,230	9	10.90	94.1	2.3	9,300	8.2	1,000	204	20
	"	10:45 A Apr. 19	680	18	9.01	94.5	4.4	1,500	8.4	550	242	25
	"	2:42 P Apr. 22	690	20	8.46	92.3	3.8	2,300	8.4	500	230	25
	"	9:25 A May 12	690	13	9.89	93.3	3.9	2,300	8.2	500	236	20
	"	9:25 A June 3	550	21	7.82	86.9	2.1	-	8.5	900	235	34
	"	9:35 A June 10	630	24	7.18	84.2	2.6	-	8.0	3,700	158	12
	"	6:15 P June 16	925	26	5.71	69.4	5.3	-	7.6	3,500	123	15
	"	8:00 A June 24	2,200	22	7.00	79.4	3.6	-	7.8	13,000	138	6.8
	"	9:10 A July 1	8,500	24	6.45	75.7	3.0	-	7.6	30,000	79	3.8
	"	9:10 A July 9	2,350	23	5.79	66.7	4.4	-	7.6	4,700	131	6.8
	"	8:35 A July 16	2,000	25	6.60	78.8	2.9	-	8.0	5,200	140	22
	"	8:55 A July 22	3,950	25	6.20	74.1	4.0	-	7.8	3,800	100	7.1
	"	12:00 M Aug. 5	1,170	23	7.55	87.0	3.8	46,000	7.9	8,000	136	15
	"	8:55 A Aug. 13	700	24	7.21	84.6	2.5	46,000	8.6	1,400	201	30
	"	10:35 A Aug.25	560	24	7.32	85.0	2.2	4,300	8.5	2,800	172	25
	"	9:45 A Sept. 8	450	18	8.59	90.1	3.0	46,000	8.1	1,900	178	33
	"	9:55 A Sept.23	160	18	8.65	90.8	4.5	9,300	8.6	400	257	11
	"	8:55 A Oct. 5	110	12	9.74	89.8	4.8	4,300	8.6	220	265	69
	"	9:35 A Oct. 28	120	9	10.40	89.8	4.4	4,300	8.4	180	243	38
	"	9:15 A Nov. 8	320	5	11.22	87.7	6.6	23,000	8.3	1,400	202	46
	"	8:50 A Nov. 10	306	2	12.55	90.7	4.9	9,300	8.3	1,100	207	35
	"	8:35 A Nov. 12	290	4	11.83	90.0	4.3	43,000	8.3	1,500	229	24
	"	9:10 A Nov. 15	310	5	11.02	86.1	4.4	24,000	8.2	2,000	232	24
	"	8:45 A Nov. 17	310	5	10.97	85.7	4.0	43,000	8.3	1,400	236	23
	"	8:50 A Nov. 22	254	0	13.46	91.9	1.7	24,000	8.2	450	236	43
	"	8:25 A Nov. 24	280	1	12.70	89.2	3.0	15,000	8.2	500	235	54
	"	9:15 A Dec. 16	425	0	13.59	92.8	2.4	9,300	8.2	900	239	23
Republican River Bridge at Clyde State Highway #9	R - 81.8	12:40 P Mar. 29	1,250	9	10.37	89.5	2.5	4,300	8.2	1,400	322	20
	"	12:02 P Apr. 1	1,250	9	10.85	93.8	2.2	15,000	8.2	900	206	21
	"	11:07 A Apr.19	640	18	9.11	95.4	4.9	4,300	8.4	600	212	24

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Est. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 61.8	2:14 P Apr. 22	650	20	8.45	92.2	3.8	4,300	8.4	500	232	24
Bridge at Clyde State Highway 89	"	9:32 A May 12	620	13	10.39	98.2	4.9	24,000	8.2	700	228	19
	"	9:50 A June 3	540	21	8.43	93.8	0.8	-	8.6	800	231	29
	"	10:00 A June 10	600	23	7.10	84.8	2.9	-	7.4	4,100	164	12
	"	6:40 P June 16	600	26	5.84	71.1	5.1	-	7.8	3,300	135	20
	"	8:25 A June 24	5,000	22	6.04	68.4	3.5	-	7.8	18,000	136	5.4
	"	9:40 A July 1	9,500	24	6.83	80.1	3.7	-	7.9	11,000	119	4.1
	"	9:35 A July 9	2,000	22	6.29	71.3	4.6	-	7.9	3,900	140	6.4
	"	9:00 A July 16	1,800	25	6.45	77.0	2.8	-	8.0	5,100	143	17
	"	9:20 A July 22	3,000	25	5.77	68.9	5.4	-	7.9	3,900	116	7.1
	"	12:25 P Aug. 5	1,000	23	0.75	8.7	14.2	46,000	7.8	9,600	144	17
	"	9:30 A Aug. 13	600	24	7.08	83.0	2.4	24,000	8.6	1,600	209	30
	"	11:20 A Aug. 25	470	24	7.29	85.4	3.0	24,000	8.5	2,400	186	28
	"	12:55 P Sept. 1	690	29	7.32	94.2	4.6	24,000	8.6	600	242	48
	"	10:10 A Sept. 8	510	18	8.60	90.2	2.8	46,000	8.1	2,200	204	30
	"	10:30 A Sept. 23	157	18	8.95	93.8	4.5	24,000	8.7	450	250	48
	"	10:05 A Oct. 5	105	13	10.04	94.8	4.5	930	8.6	160	260	68
	"	10:00 A Oct. 28	128	9	10.31	89.0	6.0	11,000	8.4	210	244	33
	"	9:45 A Nov. 8	320	4	11.31	86.2	6.2	93,000	8.3	1,400	204	35
	"	9:30 A Nov. 10	307	3	12.75	94.6	4.3	43,000	8.3	1,200	217	32
	"	9:10 A Nov. 12	291	4	11.93	90.7	4.3	93,000	8.3	1,400	235	24
	"	9:40 A Nov. 15	311	7	11.07	91.0	4.2	93,000	8.2	2,300	229	20
	"	9:20 A Nov. 17	312	5	11.03	86.2	3.8	75,000	8.2	1,400	238	22
	"	9:25 A Nov. 22	254	0	13.30	90.9	2.0	43,000	8.2	450	239	54
	"	8:45 A Nov. 24	285	1	12.75	89.5	2.9	24,000	8.2	600	230	52
	"	9:35 A Dec. 16	420	0	13.18	90.0	4.7	24,000	8.1	1,200	248	23
Salt Creek	R - 90.7 Sa.C.-0.6	1:25 P Mar.29	7	11	9.67	87.4	2.2	930	8.0	290	279	174
County Bridge 6 miles east of Concordia	"	7:50 A Apr. 6	6	12	7.68	70.8	3.7	430	8.2	200	301	252
	"	10:00 A Apr. 19	5	18	6.67	70.0	3.8	930	8.2	260	276	327
	"	1:55 P Apr. 22	5	20	6.93	75.6	3.6	2,400	7.9	180	290	339
	"	10:14 A May 12	4	12	7.76	71.6	4.3	930	7.8	220	260	275
	"	10:20 A June 3	3	21	6.50	72.3	1.0	-	7.9	320	356	272
	"	10:25 A June 10	4	23	7.37	84.9	3.7	-	8.6	150	286	328
Salt Creek	R - 90.7 Sa.C.-3.6	7:05 P June 16	2	24	3.70	43.1	>3.7	-	7.5	400	172	143
County bridge near Hollis	"	8:50 A June 24	10	20	5.57	60.7	4.3	-	7.8	900	169	79
	"	10:15 A July 1	12	23	5.89	67.8	4.8	-	7.7	2,800	153	59
	"	9:50 A July 16	3	22	4.83	54.7	2.8	-	8.2	340	315	410
	"	9:50 A July 22	100	24	4.12	48.3	2.4	-	7.6	1,600	107	53
	"	9:30 A July 29	5	25	6.85	81.8	2.0	9,300	7.9	1,200	306	285
	"	1:15 P Aug. 5	3	22	8.38	94.9	4.2	3,900	8.0	500	250	365
	"	10:35 A Aug. 13	15	23	6.74	77.7	6.0	24,000	8.3	370	249	527
	"	12:35 P Aug. 25	1	26	11.30	137.4	8.8	9,300	8.5	190	281	520
	"	12:15 P Sept. 1	0.1	25	9.68	115.0	9.2	11,000	8.6	160	306	738

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Salt Creek	R - 90.7 Sa.C.-3.6	11:05 A Sept. 8	0.1	18	6.68	70.1	4.3	11,000	7.9	180	303	712
County bridge near Hollis	"	11:20 A Sept.23	0.5	18	4.15	43.6	13.6	930	8.0	110	312	259
	"	10:40 A Oct. 28	1	9	0.00	0.0	18.8	360	7.5	50	359	202
	"	10:30 A Dec. 16	4	0	10.18	69.5	2.0	2,400	7.7	15	395	783
Republican River	R - 91.4	8:45 A July 29	760	25	6.81	81.3	2.9	24,000	8.3	1,300	198	20
No bridge - 6 miles east of Concordia -	"	12:45 P Aug. 5	850	23	0.71	8.2	11.9	24,000	8.0	7,000	134	13
Access by county road	"	1:25 P Sept. 1	750	26	6.47	78.8	5.6	9,300	8.4	3,400	227	17
	"	10:25 A Sept. 8	535	17	8.63	88.6	3.5	46,000	8.1	3,300	214	12
	"	10:50 A Sept.23	152	17	8.60	88.3	4.2	110,000	8.6	370	252	42
	"	10:25 A Oct. 5	95	14	9.44	90.9	5.6	46,000	8.5	220	257	53
	"	10:15 A Oct. 28	145	10	9.92	87.6	6.1	15,000	8.4	220	238	32
	"	10:05 A Nov. 8	320	4	11.49	87.4	6.3	93,000	8.3	1,700	199	28
	"	9:50 A Nov. 10	307	2	12.81	92.6	4.8	15,000	8.3	1,400	221	21
	"	9:30 A Nov. 12	291	4	11.99	91.2	4.1	43,000	8.3	1,300	236	18
	"	10:05 A Nov. 15	311	7	11.16	91.7	4.4	24,000	8.2	1,900	232	17
	"	9:50 A Nov. 17	314	5	11.10	86.8	3.7	43,000	8.2	1,200	237	18
	"	9:50 A Nov. 22	256	0	13.33	91.2	2.3	43,000	8.2	500	238	35
	"	9:55 A Dec. 16	410	0	13.42	91.8	2.5	110,000	8.2	500	253	21
Republican River	R - 96.2	1:43 P Mar. 29	900	11	10.44	94.4	2.3	7,500	8.2	1,300	193	17
Bridge about 4 miles East of Concordia	"	8:09 P Apr. 6	740	12	9.47	87.4	1.9	15,000	8.2	700	227	15
	"	11:35 A Apr. 19	565	18	9.08	95.2	4.7	9,300	8.4	450	233	20
	"	1:40 P Apr. 22	590	19	8.05	86.1	3.7	15,000	8.4	500	230	21
	"	10:27 A May 12	555	13	10.36	97.7	4.5	24,000	8.2	600	228	18
	"	10:25 A June 3	415	21	8.22	91.6	0.7	-	8.4	750	238	18
	"	10:35 A June 10	570	25	7.05	84.2	2.8	-	8.2	3,300	178	8.8
	"	7:20 P June 16	430	26	6.00	72.9	5.2	-	8.4	1,200	192	16
	"	9:00 A June 24	10,000	22	5.41	61.3	3.2	-	7.8	13,000	154	6.0
	"	10:30 A July 1	7,700	25	6.93	82.7	4.5	-	7.9	9,000	109	15
	"	10:00 A July 16	1,460	25	6.75	80.6	3.2	-	7.9	6,200	122	21
	"	10:10 A July 22	3,100	25	5.70	68.0	3.0	-	7.7	3,800	121	6.5
	"	9:00 A July 29	760	25	4.73	56.5	4.3	9,300	7.9	500	180	28
	"	1:00 P Aug. 5	785	23	7.30	84.2	3.4	24,000	8.0	8,000	136	13
	"	10:05 A Aug. 13	590	25	7.23	86.3	2.1	24,000	8.6	1,800	204	20
	"	12:10 P Aug. 25	420	24	7.16	84.0	2.8	24,000	8.5	2,200	174	20
	"	1:50 P Sept. 1	790	26	6.61	80.5	6.1	9,300	8.5	3,900	228	13
	"	10:45 A Sept. 8	540	18	8.68	91.0	3.2	>110,000	8.1	3,100	195	12
	"	11:05 A Sept.23	147	17	8.46	86.9	4.0	46,000	8.6	380	246	34
	"	9:45 A Oct. 5	90	12	9.64	88.9	5.6	110,000	8.5	320	252	43
	"	10:30 A Oct. 28	159	9	10.32	89.2	5.5	9,300	8.4	250	235	26
	"	10:30 A Nov. 8	321	4	11.61	88.4	5.5	43,000	8.3	1,700	195	29
	"	10:10 A Nov. 10	308	3	12.70	94.4	5.4	43,000	8.3	3,000	222	19
	"	10:00 A Nov. 12	291	4	12.05	91.8	3.6	3,900	8.3	1,200	236	18
	"	10:30 A Nov. 15	312	7	11.28	92.6	4.0	15,000	8.2	1,700	232	16

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 96.2	10:10 A Nov. 17	316	6	11.27	90.3	3.3	9,300	8.3	1,300	232	16
Bridge about 4 miles East of Concordia	"	10:15 A Nov. 22	260	0	13.41	91.7	1.6	12,000	8.2	450	235	29
	"	9:20 A Nov. 24	300	1	13.28	93.2	3.7	15,000	8.3	800	228	31
	"	10:15 A Dec. 16	405	0	13.30	90.9	1.6	24,000	8.3	380	244	20
Republican River	R - 99.0	10:30 A July 16	1,500	24	6.74	79.1	3.1	-	8.0	6,000	136	11
2 miles east and 1 mile north of Concordia	"	10:30 A July 22	2,960	25	5.98	71.4	2.7	-	7.8	3,600	122	3.6
near C.B. & Q. track	"	1:30 P Aug. 5	770	24	7.52	87.9	4.0	93,000	8.0	8,600	136	13
	"	10:55 A Oct. 5	90	15	9.39	92.4	6.9	1,500	8.6	290	250	49
	"	10:50 A Oct. 28	159	10	10.58	93.3	5.6	930	8.4	250	240	27
	"	10:45 A Dec. 16	403	0	13.40	91.6	1.8	7,500	8.1	400	255	26
Republican River	R 102.4	11:20 A Mar. 29	1,300	9	10.60	91.6	2.5	2,400	8.2	1,300	197	16
Bridge north of Concordia - U.S.	"	8:30 A Apr. 6	736	12	9.58	88.4	1.8	2,400	8.2	700	218	12
Highway No. 81	"	11:55 A Apr. 19	562	19	9.07	97.2	4.8	930	8.4	500	228	14
	"	12:43 P Apr. 22	580	18	8.37	87.8	4.0	430	8.4	450	228	16
	"	11:20 A May 12	550	15	10.63	104.7	4.0	4,600	8.3	600	224	14
	"	10:55 A June 3	410	21	8.58	95.6	1.4	-	8.3	900	227	16
	"	11:25 A June 10	568	26	7.21	87.7	3.1	-	8.2	3,600	159	15
	"	7:45 P June 16	400	25	6.20	74.1	5.7	-	8.4	900	192	19
	"	10:15 A June 24	11,200	23	5.45	62.7	2.9	-	7.6	13,000	153	6.5
	"	10:55 A July 1	7,630	25	6.75	80.6	4.6	-	7.9	10,000	128	16
	"	11:35 A July 16	1,430	24	6.31	74.0	2.8	-	8.0	5,200	138	11
	"	10:45 A July 22	2,960	25	5.39	64.4	3.7	-	7.8	4,000	120	4.6
	"	10:00 A July 29	754	24	6.78	79.6	1.8	9,300	8.3	1,000	220	18
	"	1:55 P Aug. 5	770	24	7.26	85.1	3.4	24,000	8.0	9,600	133	14
	"	10:50 A Aug. 13	578	25	7.07	84.4	6.7	24,000	8.6	2,000	203	19
	"	1:00 P Aug. 25	408	25	7.33	87.4	2.6	9,300	8.6	2,200	182	21
	"	12:00 N Sept. 1	770	26	6.85	82.3	6.1	9,300	8.5	5,000	221	11
	"	11:25 A Sept. 8	530	18	7.23	75.8	2.8	24,000	8.1	3,200	352	16
	"	11:40 A Sept.23	147	18	8.80	92.3	4.0	4,300	8.6	450	243	27
	"	11:10 A Oct. 5	90	15	9.81	96.7	4.7	2,300	8.6	240	247	37
	"	11:10 A Oct. 28	159	10	10.49	92.5	5.4	930	8.4	230	233	21
	"	10:55 A Nov. 8	321	4	12.00	91.3	4.8	43,000	8.2	1,500	196	29
	"	10:30 A Nov. 10	308	3	13.05	96.9	4.0	9,300	8.3	1,800	219	17
	"	10:25 A Nov. 12	291	5	12.28	95.8	3.9	4,300	8.3	1,200	236	16
	"	11:00 A Nov. 15	312	8	11.50	96.9	3.3	24,000	8.2	1,400	230	15
	"	10:30 A Nov. 17	316	6	11.41	91.6	3.4	24,000	8.2	1,300	233	15
	"	10:40 A Nov. 22	260	0	13.28	90.7	3.0	4,300	8.3	400	229	38
	"	9:40 A Nov. 24	300	1	13.26	93.1	3.0	7,500	8.3	800	228	32
	"	11:00 A Dec. 16	403	0	13.60	93.4	1.8	9,300	8.3	340	252	19
Wolf Creek	R - 105.0 Wo.C.-5.0	2:20 P Mar. 29	4	10	10.93	96.5	2.3	750	8.2	95	258	33
3 miles west of Concordia												

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Buffalo Creek	R - 106.2 Bu.C.-2.5	2:40 P Mar. 29	20	10	10.39	91.6	6.4	930	7.7	1,300	138	185
County bridge about 4 miles west of	"	9:02 A Apr. 6	15	12	8.93	82.4	7.6	930	7.9	400	221	254
Concordia	"	12:44 P Apr. 19	15	19	7.66	81.9	7.2	430	8.2	230	286	312
	"	1:00 P Apr. 22	15	19	5.46	58.4	5.8	72	7.9	300	282	341
	"	10:57 A May 12	10	13	7.25	68.3	2.8	11,000	8.0	260	293	331
	"	11:20 A June 3	6	21	4.56	50.7	2.6	-	8.0	500	253	157
	"	11:05 A June 10	6	24	5.59	65.7	2.6	-	8.0	4,000	260	360
Buffalo Creek	R - 106.2 Bu.C.-7.3	9:30 A June 24	6	22	5.90	66.9	3.9	-	7.9	1,300	160	39
County bridge 1/2 mile north of	"	11:20 A July 1	20	26	5.39	65.6	3.0	-	7.7	500	122	488
Highway #28, 6 miles West of Concordia	"	11:10 A July 16	10	24	4.42	51.8	4.1	-	7.8	1,400	156	131
	"	11:15 A July 22	1,800	25	3.13	37.4	-	-	7.7	2,200	82	6.0
	"	10:40 A July 29	40	25	5.43	64.9	3.8	24,000	8.0	800	283	204
	"	11:20 A Aug. 13	10	24	9.41	110.2	7.0	4,600	7.8	200	327	286
	"	1:20 P Aug. 25	2.5	26	9.27	112.7	13.1	930	8.6	200	352	358
	"	11:20 A Sept. 1	2.6	25	6.77	80.8	5.8	930	8.4	110	357	230
	"	11:50 A Sept. 8	6	18	8.70	91.2	7.1	4,600	8.1	230	193	308
	"	12:00 N Sept.23	1	19	6.85	73.3	>6.6	2,400	8.4	360	377	385
	"	11:35 A Oct. 5	1	14	8.83	85.2	7.4	1,500	8.5	230	382	440
	"	11:30 A Oct. 28	2	11	6.67	60.3	9.8	430	8.4	170	464	440
	"	11:20 A Dec. 16	10	0	15.15	103.5	2.0	230	7.9	20	415	358
Republican River	R - 125.2	10:25 A Mar. 29	600	8	10.75	90.6	2.1	9,300	8.2	1,200	216	5.8
Bridge - U. S. Highway #36, west of	"	7:05 A Apr. 6	810	11	9.50	85.8	1.7	2,300	8.4	700	223	8.7
Scandia	"	9:12 A Apr. 19	655	16	9.17	92.2	4.5	1,500	8.4	500	227	12
	"	11:45 A Apr. 22	620	17	8.77	90.0	3.6	4,300	8.4	550	222	55
	"	12:09 P May 12	600	16	10.21	102.7	3.3	9,300	8.3	450	242	7.8
	"	12:10 P June 3	480	24	8.49	99.5	1.4	-	8.1	900	239	9.6
	"	12:10 P June 10	500	27	7.10	88.0	2.5	-	8.0	1,800	168	12
	"	9:00 P June 16	390	25	6.26	74.7	6.0	-	8.4	600	197	12
	"	11:15 A June 24	13,500	21	5.60	62.3	3.7	-	7.6	15,000	171	12
	"	12:35 P July 1	7,000	25	7.10	84.8	4.0	-	7.7	9,600	127	5.9
	"	12:25 P July 16	1,600	25	7.05	84.2	2.5	-	8.0	4,700	149	4.8
	"	12:30 P July 22	1,670	26	6.83	83.0	6.1	-	8.0	5,500	150	5.6
	"	12:00 N July 29	835	27	7.04	87.1	3.7	9,300	8.3	1,800	205	9.2
	"	4:10 P Aug. 5	710	25	6.82	81.5	3.0	24,000	7.9	7,600	132	4.6
	"	12:00 N Aug. 13	1,070	25	7.00	83.6	2.1	-	8.6	1,600	196	8.5
	"	2:15 P Aug. 25	350	27	7.10	88.0	3.6	46,000	8.6	1,700	188	7.6
	"	10:45 A Sept. 1	635	25	7.07	84.4	5.5	24,000	8.0	13,000	158	4.1
	"	12:55 P Sept. 8	380	21	8.46	94.3	4.0	24,000	7.9	3,700	188	10
	"	12:45 P Sept.23	125	18	8.80	92.3	5.0	24,000	8.6	450	225	10
	"	12:05 P Oct. 5	70	12	9.18	84.6	4.7	930	8.6	260	233	10
	"	12:15 P Oct. 28	170	12	10.74	99.2	6.3	2,400	8.5	260	225	7.8
	"	11:50 A Nov. 8	300	4	12.18	92.6	4.0	43,000	8.3	1,300	210	7.6
	"	11:15 A Nov. 10	307	3	13.30	98.7	3.9	24,000	8.3	1,300	225	8.6

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
Republican River Bridge - U. S. Highway #36, west of Scandia	R - 125.2	11:10 A Nov. 12	293	4	12.02	91.6	5.6	15,000	8.3	2,800	230	8.5
	"	11:45 A Nov. 15	300	9	11.51	99.4	3.2	4,300	8.3	1,400	229	7.5
	"	11:10 A Nov. 17	300	6	11.39	91.3	3.3	24,000	8.2	1,300	234	7.6
	"	11:30 A Nov. 22	300	0	13.25	90.6	1.3	1,500	8.3	320	226	7.8
	"	10:15 A Nov. 24	335	1	13.06	91.7	2.5	9,300	8.2	550	218	8.4
	"	12:05 P Dec. 16	370	0	13.44	91.9	1.4	24,000	8.3	340	245	9.4
White Rock Creek Below Lovewell Damsite, 1/2 mile N.W. of Lovewell	R - 136.5 WRC - 9.5	10:05 A Mar. 30	8.6	11	9.53	86.1	1.7	73	8.2	190	269	16
	"	10:05 A Apr. 6	5.4	12	11.23	103.6	5.0	150	8.4	110	260	20
	"	1:40 P Apr. 19	4.9	20	10.40	113.3	5.6	240	8.0	75	238	23
	"	10:55 A Apr. 22	4.9	17	7.08	72.7	3.9	230	8.2	45	249	118
	"	10:20 A May 11	4.3	12	10.06	92.8	3.1	230	7.9	85	329	25
	"	2:30 P June 1	6.5	24	5.85	68.6	3.7	-	7.6	650	172	13
	"	7:25 A June 7	1.6	21	3.73	41.4	3.8	-	8.4	210	146	12
	"	7:55 A June 21	222	19	4.54	48.6	8.5	-	7.4	12,000	104	4.4
	"	8:05 A July 6	3.6	25	4.18	49.9	2.5	-	8.2	260	185	5.2
	"	7:45 A July 19	2.4	23	5.01	57.7	>5.0	-	7.9	270	200	1.4
	"	8:40 A Aug. 2	10.9	22	5.92	67.0	2.9	110,000	7.6	4,000	116	1.7
	"	8:25 A Aug. 12	0.7	22	5.04	57.1	4.2	3,900	7.6	180	206	5.3
	"	8:40 A Aug. 26	0	23	4.25	49.0	>4.2	4,300	7.9	240	172	3.1
	"	7:55 A Sept.13	0	18	5.12	53.7	4.0	11,000	7.8	140	198	8.5
	"	8:55 A Dec. 1	5	1	11.24	79.0	4.0	91	7.9	20	321	14
	"	7:55 A Dec. 23	1.5	0	13.70	93.6	7.6	14	7.9	45	392	23
Republican River County Bridge, 1 mile south of Hardy, Nebr. - in Kansas	R - 145.1	11:33 A Mar. 30	810	12	9.95	91.8	2.0	4,300	8.2	650	211	6.2
	"	10:40 A Apr. 6	714	12	9.54	88.0	1.8	2,300	8.4	700	228	6.4
	"	2:09 P Apr. 19	505	21	9.25	102.5	4.2	3,900	8.4	550	241	9.4
	"	10:12 A Apr. 22	519	16	7.69	77.3	2.9	1,500	8.4	350	230	42
	"	9:50 A May 11	492	11	10.50	94.9	3.1	4,300	8.3	700	203	10
	"	1:50 P June 1	406	25	7.87	94.0	3.0	-	8.3	1,600	206	7.2
	"	8:00 A June 7	762	24	6.66	78.2	4.1	-	7.9	3,800	308	4.8
	"	8:30 A June 21	1,460	19	7.80	83.5	6.0	-	8.0	13,000	144	4.8
	"	8:30 A July 6	1,000	26	6.59	80.1	2.7	-	8.2	3,000	168	6.9
	"	8:45 A July 19	909	23	6.78	78.1	4.7	-	8.0	3,600	168	3.2
	"	9:15 A Aug. 2	1,390	23	6.67	76.9	3.5	110,000	7.7	7,600	121	1.6
	"	8:50 A Aug. 12	424	24	6.98	81.9	2.4	110,000	8.4	1,700	200	7.0
	"	9:05 A Aug. 26	187	24	7.13	83.6	3.5	46,000	8.7	1,000	212	9.0
	"	8:30 A Sept.13	264	19	8.05	86.2	4.2	46,000	8.4	1,200	187	5.9
	"	2:00 P Sept.24	45	23	8.03	92.6	5.3	9,300	8.6	280	227	11
	"	8:15 A Oct. 4	78	12	9.43	86.8	5.2	46,000	8.4	250	222	10
	"	8:45 A Oct. 22	78	7	10.95	90.1	5.6	15,000	8.3	120	227	8.8
	"	9:20 A Dec. 1	435	1	13.23	93.0	5.6	15,000	8.3	1,500	220	7.7
	"	8:20 A Dec. 23	372	0	13.50	92.3	2.3	4,600	8.3	450	236	8.0

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River About 2 miles west of Hardy - no bridge in Kansas	R - 147.5	12:32 P Mar. 30	766	13	9.75	92.1	2.0	4,300	8.2	800	212	6.5
	"	6:55 A Apr. 8	605	9	9.76	84.3	1.7	2,300	8.3	700	237	4.8
	"	11:45 A Apr. 16	492	18	9.70	101.6	3.5	4,600	8.4	500	239	8.9
	"	3:58 P Apr. 27	505	21	8.64	96.1	5.0	24,000	8.5	290	212	8.4
	"	9:35 A May 11	490	11	10.48	94.7	4.6	24,000	8.3	650	262	10
	"	1:35 P June 1	406	25	8.02	95.8	3.3	-	8.4	1,200	210	9.6
	"	8:20 A June 7	762	24	6.62	77.6	3.7	-	8.0	4,200	144	4.4
	"	8:50 A July 6	963	27	6.55	81.2	2.9	-	8.2	2,900	162	5.6
	"	9:30 A Aug. 2	1,340	23	6.70	77.3	3.6	460,000	7.7	13,000	126	1.7
	"	9:05 A Aug. 12	415	24	7.10	83.3	2.5	15,000	8.5	1,600	200	7.6
	"	9:20 A Aug. 26	185	23	6.82	78.6	3.1	9,300	8.7	1,000	212	9.0
	"	8:45 A Sept.13	260	20	7.82	85.3	3.9	9,300	8.5	1,400	187	5.7
	"	1:45 P Sept.24	45	22	8.60	97.4	7.0	46,000	8.5	450	224	11
	"	8:30 A Oct. 4	78	12	9.39	86.5	4.6	9,300	8.4	240	223	12
	"	9:00 A Oct. 22	78	8	10.36	87.3	6.3	24,000	8.3	140	226	9.4
Republican River 3 miles east of Superior, Nebr. (no bridge)	R - 151.2	7:30 A Apr. 8	605	9	9.97	86.1	1.8	2,300	8.3	600	232	7.1
	"	11:25 A Apr. 16	500	16	9.44	94.9	4.4	>11,000	8.4	500	240	7.3
	"	4:51 P Apr. 27	515	20	8.88	96.9	5.2	110,000	8.5	290	218	7.3
	"	9:15 A May 11	475	11	10.24	92.7	3.9	24,000	8.3	650	241	1.0
	"	1:15 P June 1	406	24	7.78	91.2	4.7	-	8.2	1,400	163	6.8
	"	8:45 A June 7	770	24	6.30	73.8	4.5	-	7.9	4,100	145	2.8
	"	9:15 A July 6	945	27	6.70	83.1	2.9	-	8.2	3,600	162	5.7
	"	9:55 A Aug. 2	1,330	23	6.52	75.2	4.2	240,000	7.7	13,000	120	1.6
	"	9:25 A Aug.12	400	25	6.81	81.3	3.5	15,000	8.5	1,900	206	10
	"	9:40 A Aug. 26	180	24	6.70	78.5	2.8	24,000	8.7	800	208	8.5
	"	9:00 A Sept.13	255	21	7.77	86.4	3.6	9,300	8.5	1,900	181	6.0
	"	1:30 P Sept.24	85	21	8.19	91.2	7.4	>110,000	8.5	250	217	11
	"	8:45 A Oct. 4	75	12	8.10	74.7	6.7	46,000	8.0	2,100	232	11
	"	9:15 A Oct. 22	120	10	9.96	87.7	6.4	24,000	8.3	140	229	8.7
	"	8:50 A Dec. 23	375	0	13.40	91.6	1.6	11,000	8.3	400	236	7.9
Republican River Bridge west of Superior - State Highway No. 14	R - 157.9	1:58 P Mar. 30	775	13	9.72	91.8	1.6	4,300	8.2	800	223	6.7
	"	7:55 A Apr. 8	605	9	10.04	86.8	1.5	4,300	8.3	600	231	7.1
	"	12:07 P Apr. 16	500	17	10.25	105.4	3.1	360	8.4	380	234	7.8
	"	4:51 P Apr. 27	520	21	8.72	97.1	3.7	230	8.5	310	212	8.2
	"	8:50 A May 11	450	10	10.08	89.0	2.6	930	8.3	650	252	11
	"	12:35 P June 1	406	23	8.30	95.7	2.0	-	8.4	800	204	7.8
	"	9:20 A June 7	775	25	6.91	82.5	4.2	-	8.0	3,800	172	3.2
	"	9:10 A June 21	1,400	19	7.68	82.2	5.6	-	7.9	8,800	144	4.2
	"	9:35 A July 6	945	28	6.57	82.9	2.9	-	8.2	3,000	168	6.5
	"	9:15 A July 19	927	24	5.32	62.4	4.0	-	7.6	6,000	124	4.9
	"	10:10 A Aug. 2	1,320	24	6.84	80.3	4.4	46,000	7.7	12,000	119	1.5
	"	9:45 A Aug.12	380	26	9.52	115.9	5.0	110,000	8.5	13,800	208	7.8
	"	10:00 A Aug.26	175	24	7.25	84.9	2.5	4,300	8.8	600	212	8.3

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River Bridge west of Superior - State Highway No. 14	R - 157.9	9:15 A Sept.13	250	22	0.00	0.0	14.1	460,000	8.4	18,000	186	6.3
	"	1:15 P Sept. 24	85	20	0.00	0.0	10.8	9,300	8.5	1,000	215	[illegible]
	"	9:00 A Oct. 4	80	13	9.10	85.8	5.0	910	8.3	180	213	11
	"	9:50 A Oct. 22	125	8	10.73	90.6	6.2	430	8.2	140	226	8.8
	"	9:55 A Dec. 1	500	1	13.30	93.4	2.5	9,300	8.3	1,600	218	7.2
	"	9:05 A Dec. 23	370	0	13.27	90.6	1.4	4,600	8.3	400	233	8.5
Republican River Bridge at Guide Rock - State Highway No. 78	R - 174.3	9:16 A Mar. 31	730	8	10.42	87.8	2.0	4,300	8.2	700	217	6.4
	"	9:04 A Apr. 8	600	8	10.50	88.5	1.7	2,300	8.3	650	228	7.4
	"	10:45 A Apr. 16	520	15	9.72	95.8	3.2	1,500	8.4	500	237	7.4
	"	2:58 P Apr. 27	420	21	9.13	101.5	5.0	1,500	8.5	340	216	8.1
	"	7:40 A May 11	420	9	10.50	90.7	2.8	9,300	8.3	650	253	11
	"	10:35 A May 24	250	19	8.89	95.2	5.2	-	8.4	150	213	8.4
	"	11:50 A June 1	500	21	8.32	92.5	4.1	-	8.4	2,600	166	9.8
	"	10:35 A June 7	600	25	6.68	79.7	4.7	-	8.0	3,800	182	3.2
	"	10:30 A June 21	1,200	19	7.99	[illegible]	5.7	-	7.9	9,400	147	5.9
	"	10:30 A July 6	1,000	28	6.64	83.8	2.9	-	8.2	2,300	175	6.2
	"	10:05 A July 19	1,200	24	6.90	80.9	4.5	-	8.0	6,000	166	6.1
	"	12:00 N Aug. 2	650	25	7.20	86.0	4.3	46,000	7.7	10,000	126	1.9
	"	10:40 A Aug. 12	330	26	7.44	90.4	3.2	4,300	8.6	2,200	209	8.2
	"	10:50 A Aug. 26	220	24	7.75	90.8	3.4	15,000	8.7	1,800	216	8.2
	"	10:45 A Sept.13	220	23	8.40	96.8	3.8	15,000	8.4	2,000	182	5.1
	"	11:55 A Sept.24	90	18	9.17	96.2	5.7	7,500	8.6	300	220	10
	"	9:45 A Oct. 4	60	13	10.24	96.7	5.2	2,400	8.3	180	213	11
	"	10:40 A Oct. 22	130	9	11.50	99.3	6.8	2,400	8.3	190	215	8.2
	"	11:05 A Dec. 1	490	0	13.20	90.2	2.9	24,000	8.3	1,300	219	7.0
	"	9:55 A Dec.23	280	0	13.14	89.9	1.4	4,600	8.3	350	234	7.7
Republican River 3 miles west of Guide Rock - no bridge	R - 178.8	9:55 A Mar. 31	720	8	10.56	89.0	2.0	7,500	8.2	900	217	6.3
	"	8:47 A Apr. 8	590	8	10.51	88.6	1.9	4,300	8.3	650	230	5.8
	"	2:43 P Apr. 27	420	20	8.79	95.8	4.5	910	8.5	350	215	8.1
	"	8:00 A May 11	410	9	10.21	88.3	3.6	9,300	8.3	600	252	10
	"	10:55 A May 24	250	19	8.98	96.1	4.9	-	8.3	150	218	9.0
	"	11:30 A June 1	520	22	8.00	90.6	4.0	-	8.5	2,400	185	7.6
	"	10:20 A June 7	580	25	6.70	80.0	3.9	-	8.0	3,900	190	3.6
	"	10:15 A June 21	1,200	19	8.17	87.5	5.9	-	7.9	11,000	140	4.7
	"	10:45 A July 6	1,000	28	6.32	79.7	2.2	-	8.2	2,500	180	5.7
	"	10:30 A July 19	1,200	25	6.97	83.2	4.5	-	8.4	5,200	180	6.4
	"	12:15 P Aug. 2	640	25	7.10	84.8	4.6	>110,000	7.7	12,000	117	0.9
	"	11:00 A Aug.12	330	26	7.24	88.0	4.1	46,000	8.6	2,200	216	8.1
	"	11:10 A Aug. 26	220	24	7.50	87.9	3.7	15,000	8.7	1,900	216	7.2
	"	11:05 A Sept.13	220	22	8.17	92.6	3.4	46,000	8.5	1,800	180	4.1
	"	11:30 A Sept.24	90	17	9.10	93.5	5.5	46,000	8.6	360	227	9.5
	"	10:05 A Oct. 4	65	13	9.93	93.6	5.6	46,000	8.5	230	215	9.4
	"	11:00 A Oct. 22	135	9	11.48	99.1	7.6	7,500	8.2	260	212	8.2

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 178.8	11:35 A Dec. 1	490	1	12.47	87.5	3.4	24,000	8.3	1,200	208	7.0
3 miles west of Guide Rock - No	"	10:15 A Dec.23	280	0	13.49	92.2	1.2	1,500	8.3	290	237	7.8
bridge.												
Elm Creek	R - 179.7 E.C.-2.0	10:49 A Mar. 31	16	9	11.04	95.4	1.0	91	8.0	30	199	9.7
Bridge - State Highway No. 3.	"	9:27 A Apr. 8	16.5	7	11.51	94.7	1.3	930	8.0	20	200	9.3
4 miles east of Red Cloud	"	10:20 A Apr. 16	15.5	13	10.52	99.5	1.0	4,600	8.2	15	204	10
	"	2:18 P Apr. 27	14.5	21	8.61	97.8	1.7	430	8.5	30	200	9.2
	"	7:20 A May 11	14	8	10.63	89.8	1.0	2,400	8.0	20	222	10
	"	10:10 A May 24	13	15	9.44	92.9	0.9	-	8.3	25	203	8.8
	"	11:05 A June 1	12.5	18	9.02	94.7	0.8	-	8.1	25	203	9.4
Republican River	R - 184.5	11:15 A June 7	-	25	6.82	81.3	4.7	-	8.0	3,600	172	3.2
No bridge. 2 miles east of Red Cloud	"	11:05 A June 21	-	20	7.81	85.2	5.2	-	7.9	12,000	142	4.6
	"	11:05 A July 6	-	29	6.70	86.3	3.1	-	8.3	2,600	180	6.4
	"	10:50 A July 19	-	25	6.99	83.4	4.6	-	8.3	4,300	190	6.6
	"	12:35 P Aug. 2	620	25	7.20	86.0	4.5	24,000	7.7	11,000	124	1.3
	"	11:20 A Aug. 12	320	26	7.30	88.8	4.4	24,000	8.6	1,700	217	8.3
	"	11:25 A Aug. 26	210	25	7.60	90.7	3.5	15,000	8.8	2,100	220	8.8
	"	11:20 A Sept.13	210	24	8.21	96.3	3.3	9,300	8.5	1,700	185	5.7
	"	11:10 A Sept.24	90	17	9.15	94.0	5.4	2,400	8.6	340	218	10
	"	10:30 A Oct. 4	65	14	10.16	98.0	5.5	4,600	8.5	190	211	10
	"	11:15 A Oct. 22	135	10	11.73	103.6	7.4	4,600	8.0	260	212	7.9
	"	11:55 A Dec. 1	480	1	13.17	92.4	3.2	2,300	8.3	1,200	217	7.0
	"	10:35 A Dec.23	270	0	13.39	91.5	1.8	2,400	8.4	250	238	8.1
Republican River	R 186.7	11:10 A Mar. 31	700	9	10.60	91.6	2.0	4,300	8.2	800	220	5.9
Bridge - U. S. Highway No. 281,	"	9:47 A Apr. 8	570	9	10.49	90.6	2.4	730	8.3	550	234	6.9
South of Red Cloud	"	2:00 P Apr. 16	500	18	9.93	104.0	4.2	1,500	8.4	450	237	7.9
	"	1:15 P Apr. 27	400	20	8.98	97.9	4.4	930	8.5	350	214	8.0
	"	7:00 A May 11	390	8	10.29	86.7	3.0	2,400	8.3	550	241	11
	"	11:30 A May 24	240	21	8.87	98.6	5.1	-	8.4	150	220	8.0
	"	10:40 A June 1	550	21	8.16	90.8	3.8	-	8.5	2,200	208	8.8
	"	11:25 A June 7	550	26	6.56	79.7	4.4	-	7.9	3,200	176	6.8
	"	11:15 A June 21	1,100	20	7.90	86.2	5.4	-	7.9	12,000	140	6.4
	"	11:15 A July 6	1,000	28	6.76	85.4	3.2	-	8.3	2,600	189	8.1
	"	11:00 A July 19	1,160	25	6.62	79.1	4.2	-	8.2	4,000	188	5.4
	"	12:50 P Aug. 2	610	25	7.18	85.7	4.4	46,000	7.7	11,000	120	2.1
	"	11:35 A Aug. 12	320	26	7.43	90.2	4.3	9,300	8.6	1,700	212	8.5
	"	11:40 A Aug. 26	210	25	8.80	104.9	3.6	4,300	8.7	1,800	220	9.5
	"	11:35 A Sept.13	210	24	8.22	96.3	3.4	24,000	8.5	1,600	186	6.1
	"	11:00 A Sept.24	85	17	9.46	97.2	5.5	9,300	8.5	350	211	9.2
	"	10:45 A Oct. 4	70	14	10.12	97.7	5.2	9,300	8.4	190	208	9.4
	"	11:35 A Oct. 22	140	10	11.68	102.9	6.7	910	8.3	350	222	6.8
	"	12:10 P Dec. 1	480	2	13.09	94.5	2.9	15,000	8.3	1,200	220	7.4
	"	10:50 A Dec. 23	270	0	13.33	91.1	1.0	1,200	8.3	240	234	8.1

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
Republican River	R - 197.8	12:30 P Mar. 30	730	12	9.62	88.8	2.0	9,300	8.2	700	219	3.8
Bridge at Inavale	"	10:25 A Apr. 8	560	10	10.53	92.9	2.1	4,300	8.3	550	235	7.8
	"	9:52 A Apr. 16	490	14	9.74	93.9	3.5	1,500	8.4	500	240	7.9
	"	1:32 P Apr. 27	390	21	8.83	98.3	4.0	360	8.5	340	216	7.1
	"	12:15 P May 10	430	13	10.09	95.2	3.2	12,000	8.6	450	241	9.5
	"	9:50 A May 24	240	19	8.96	96.9	4.7	-	8.4	150	225	8.2
	"	10:15 A June 1	570	21	8.13	90.6	4.4	-	8.5	2,200	173	8.6
	"	12:00 N June 7	530	26	6.55	79.6	5.1	-	7.7	3,900	139	4.0
	"	11:35 A June 21	1,050	20	8.02	87.4	4.3	-	7.9	11,000	138	4.8
	"	11:35 A July 6	1,000	29	6.63	85.3	2.8	-	8.2	2,200	192	8.2
	"	11:20 A July 19	1,150	24	6.82	80.0	4.4	-	8.2	5,800	162	4.4
	"	1:15 P Aug. 2	600	25	7.26	86.7	4.5	24,000	7.7	10,000	122	2.6
	"	11:55 A Aug. 12	320	27	7.60	94.1	5.2	24,000	8.6	1,600	212	8.3
	"	12:00 N Aug. 26	200	26	7.05	85.8	3.4	46,000	8.8	1,600	224	9.1
	"	11:55 A Sept.13	210	26	8.36	101.5	3.5	9,300	8.5	1,600	192	5.5
	"	10:30 A Sept.24	85	17	8.91	91.4	5.0	910	8.6	310	232	10
	"	11:00 A Oct. 4	70	15	9.77	96.2	4.7	4,600	8.4	190	220	9.1
	"	11:50 A Oct. 22	140	10	11.61	102.4	6.9	11,000	8.0	400	212	7.6
	"	12:35 P Dec. 1	475	1	12.77	89.6	4.7	9,300	8.3	1,900	215	7.0
	"	11:10 A Dec. 23	270	0	13.29	90.8	1.2	11,000	8.3	230	233	8.7
Thompson Creek												
No bridge - 1 mile north of Riverton	R - 205.6 Th.C.-1.2	9:25 A May 24	-	18	8.74	91.6	1.0	-	8.3	25	174	5.0
	"	9:50 A June 1	-	19	8.81	94.3	1.3	-	8.4	25	174	6.8
	"	12:20 P June 7	-	30	7.07	92.7	1.5	-	8.4	25	133	4.8
	"	11:55 A June 21	-	21	8.21	91.3	1.3	-	8.5	25	173	7.8
	"	11:55 A July 6	-	30	6.72	88.1	0.7	-	8.3	60	178	7.6
	"	11:45 A July 19	-	25	7.30	87.2	1.0	-	8.3	250	156	6.7
	"	1:35 P Aug. 2	19	25	6.79	81.2	1.0	9,300	8.2	120	172	6.6
	"	12:15 P Aug. 12	18	30	7.00	91.8	0.9	24,000	8.5	60	176	7.1
	"	12:20 P Aug. 26	13.5	28	7.30	92.2	0.7	9,300	8.6	45	166	7.7
	"	12:10 P Sept.13	14	26	7.70	93.7	1.0	4,600	8.5	60	179	6.5
	"	10:10 A Sept.24	12.5	17	9.26	95.2	0.9	3,400	8.3	35	182	7.2
	"	11:15 A Oct. 4	19	16	10.04	101.0	1.1	2,400	8.5	25	180	7.6
	"	12:05 P Oct. 22	24	13	10.50	99.1	2.2	430	8.2	45	172	5.6
	"	12:55 P Dec. 1	25	5	11.66	91.0	1.2	230	8.2	25	167	7.0
	"	11:25 A Dec. 23	23	0	12.81	87.6	1.0	1,100	8.2	35	162	6.7
Republican River	R - 206.2	12:00 N Mar. 30	710	12	9.87	91.1	2.0	930	8.2	800	218	6.9
Bridge at Riverton	"	9:50 A Apr. 8	540	10	10.55	93.1	2.2	11,000	8.3	450	236	9.3
	"	9:20 A Apr. 16	480	16	9.48	95.3	3.4	4,300	8.4	500	245	7.4
	"	1:14 P Apr. 27	370	19	9.02	96.7	4.6	360	8.5	360	217	8.1
	"	12:35 P May 10	420	13	10.09	95.2	3.4	2,300	8.6	450	245	10
	"	9:15 A May 24	230	18	8.91	93.4	4.6	-	8.4	150	230	8.2
	"	9:30 A June 1	600	20	8.21	89.6	4.4	-	8.6	2,000	202	8.8
	"	12:30 P June 7	510	27	6.83	84.6	4.6	-	7.9	2,400	197	3.6

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 206.2	12:05 P June 21	1,000	19	8.07	86.4	4.7	-	8.0	10,000	140	5.1
Bridge at Riverton	"	12:05 P July 6	1,000	28	6.66	84.1	2.5	-	8.3	1,900	190	8.1
	"	11:35 A July 19	1,140	25	6.95	82.9	3.8	-	8.3	6,200	184	4.5
	"	1:50 P Aug. 2	580	27	7.16	88.7	3.4	46,000	7.9	6,300	120	3.1
	"	12:30 P Aug. 12	310	28	7.65	96.7	5.6	9,300	8.6	1,500	216	9.1
	"	12:35 P Aug. 26	180	26	7.50	91.1	5.0	24,000	8.7	1,400	218	9.2
	"	12:25 P Sept.13	195	25	8.34	99.6	3.8	24,000	8.5	1,600	198	6.1
	"	10:00 A Sept.24	70	17	9.04	92.8	5.4	24,000	8.7	400	238	10
	"	11:30 A Oct. 4	55	16	9.69	97.3	4.9	4,300	8.4	210	236	9.5
	"	12:20 P Oct. 22	120	11	11.78	106.2	7.2	4,600	8.2	400	222	8.4
	"	1:15 P Dec. 1	450	3	12.70	94.3	4.6	4,300	8.3	2,200	216	6.6
	"	11:40 A Dec.23	250	0	13.30	90.9	1.0	930	8.3	170	243	8.1
Republican River	R - 214.6	6:00 A June 7	490	17	6.61	67.9	3.2	9,300	8.3	2,600	162	6.1
3-1/2 miles east of Franklin - no bridge	"	7:00 A June 16	500	22	6.99	79.2	4.3	110,000	8.0	12,000	124	2.9
	"	9:10 A June 25	3,200	20	7.02	76.6	3.6	93,000	7.7	7,000	124	3.3
	"	5:35 A July 12	1,700	23	6.44	74.2	3.9	93,000	7.9	14,000	127	2.7
	"	9:25 A July 20	1,100	23	7.40	85.3	4.1	23,000	8.0	6,200	144	3.2
	"	6:40 A July 30	700	19	6.43	68.8	4.4	23,000	8.3	6,600	148	3.0
	"	6:45 A Aug. 9	350	21	6.98	77.8	3.0	24,000	8.4	2,400	209	7.8
	"	1:30 P Aug. 26	180	26	7.58	92.1	5.4	15,000	8.8	1,400	216	9.3
	"	1:15 P Sept. 3	190	25	8.17	97.6	4.7	24,000	8.5	1,400	202	5.3
	"	9:20 A Sept.24	70	15	8.90	87.6	4.1	4,300	8.7	320	247	10
	"	12:30 P Oct. 4	60	17	9.20	94.5	3.9	46,000	8.4	160	243	8.4
	"	1:10 P Oct. 22	125	12	11.11	102.6	6.1	9,300	8.3	550	251	8.4
	"	2:15 P Dec. 1	450	3	12.50	92.8	4.6	43,000	8.3	3,500	217	6.9
	"	12:30 P Dec. 23	240	0	13.34	91.2	0.9	4,600	8.3	200	242	7.9
Republican River	R - 216.8	6:30 A June 7	480	18	7.10	74.4	3.7	4,300	8.3	2,600	167	6.7
1-1/2 miles east of Franklin - no bridge	"	7:20 A June 16	470	22	7.60	86.1	4.8	46,000	8.1	14,000	138	3.2
	"	9:20 A June 25	3,000	20	7.07	77.1	3.6	240,000	7.7	7,000	148	3.8
	"	5:55 A July 12	1,700	22	6.83	77.3	4.7	24,000	8.1	13,500	133	2.5
	"	9:35 A July 20	1,100	24	7.60	89.1	4.4	23,000	8.0	5,300	150	3.9
	"	6:50 A July 30	750	19	6.58	70.4	4.0	43,000	8.2	5,800	142	2.8
	"	6:55 A Aug. 9	350	21	[illegible].30	81.2	2.8	21,000	8.4	2,200	207	5.4
	"	1:15 P Aug. 26	180	26	7.82	95.2	5.2	15,000	8.8	1,300	216	8.7
	"	1:00 P Sept.13	190	25	8.22	98.1	4.3	21,000	8.6	1,400	199	5.5
	"	9:20 A Sept.24	70	16	9.31	93.6	4.8	4,300	8.7	280	247	9.6
	"	12:15 P Oct. 4	60	17	9.13	93.8	3.8	46,000	8.4	150	241	8.6
	"	12:55 P Oct. 22	130	12	11.51	106.2	5.9	2,300	8.3	600	245	7.9
	"	2:00 P Dec. 1	450	3	12.53	93.1	4.4	15,000	8.3	3,400	217	7.1
	"	12:15 P Dec.23	240	0	13.20	90.3	1.4	1,500	8.3	200	247	8.3
Republican River	R - 218.4	11:30 A Mar. 30	690	11	9.88	89.2	2.2	24,000	8.2	700	220	5.5
Bridge - State Highway No. 10. South of Franklin	"	9:30 A Apr. 8	525	10	10.74	94.8	2.4	1,500	8.3	600	239	9.2

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River - Bridge - State Highway No. 10, South of Franklin	R - 218.4	9:10 A Apr. 15	480	14	9.07	87.5	2.7	360	8.4	400	240	6.6
	"	12:47 P Apr. 27	350	19	8.57	91.7	4.0	750	8.5	380	220	7.9
	"	11:30 A May 10	415	12	10.07	93.0	3.3	9,300	8.5	400	253	9.2
	"	8:30 A May 24	220	17	8.97	92.2	4.8	-	8.4	170	228	7.2
	"	6:45 A June 7	470	18	7.05	73.9	3.8	24,000	8.3	2,600	176	5.9
	"	7:35 A June 16	450	22	7.12	80.6	4.8	46,000	8.0	16,000	142	3.5
	"	9:35 A June 25	3,200	20	7.02	76.6	3.4	43,000	7.8	6,600	124	2.4
	"	6:05 A July 12	1,700	22	6.47	73.3	4.4	43,000	8.0	13,500	140	3.4
	"	9:55 A July 20	1,100	24	7.36	86.3	4.4	15,000	8.0	5,600	144	3.9
	"	7:05 A July 30	800	19	6.59	70.5	4.3	93,000	8.2	5,600	139	3.3
	"	7:10 A Aug. 9	350	21	7.39	82.2	3.4	9,300	8.4	2,300	208	8.0
	"	1:00 P Aug. 26	175	26	8.20	99.6	5.7	9,300	8.7	1,400	216	8.8
	"	12:45 P Sept. 13	190	24	8.34	97.8	4.6	4,300	8.6	1,400	204	5.7
	"	9:10 A Sept. 24	72	16	9.21	92.6	4.4	2,300	8.4	290	224	9.0
	"	11:50 A Oct. 4	65	16	9.78	98.3	3.8	360	8.3	160	230	7.8
	"	12:35 P Oct. 22	135	11	11.60	104.9	6.3	11,000	8.3	800	248	7.5
	"	1:45 P Dec. 1	450	3	12.65	93.9	5.4	9,300	8.3	3,600	214	7.1
	"	12:00 N Dec. 23	240	0	13.15	89.8	1.7	430	8.3	180	241	8.2
Turkey Creek Bridge - north of Naponee	R - 232.3 Tur.C.-2.0	10:55 A Mar. 30	11	13	9.64	91.0	0.6	430	8.2	45	254	4.8
	"	9:05 A Apr. 8	11	7	11.53	94.9	1.2	4,600	8.1	20	252	6.9
	"	9:45 A Apr. 15	12.5	15	10.20	100.5	1.1	430	8.3	20	256	5.4
	"	11:50 A Apr. 27	14	19	9.48	101.2	1.4	4,600	8.3	15	242	5.8
	"	11:05 A May 10	9.7	13	9.94	93.7	1.1	2,400	8.3	35	263	7.2
	"	8:00 A May 24	10	15	9.05	89.2	1.3	-	8.2	65	260	5.0
	"	7:15 A June 7	7.9	15	7.99	78.7	1.5	2,400	8.2	70	268	6.1
	"	8:10 A June 16	9.2	18	8.40	88.1	1.1	11,000	8.3	35	261	8.4
	"	10:00 A June 25	12	21	9.13	101.6	1.6	2,300	8.4	45	253	5.7
	"	7:05 A July 12	9.2	18	8.14	85.3	1.2	4,300	8.3	550	253	5.7
	"	10:25 A July 20	7.0	23	7.63	87.9	2.3	24,000	8.1	180	220	4.6
	"	8:15 A July 30	20	17	7.52	77.2	1.8	43,000	8.3	360	208	4.0
	"	7:35 A Aug. 9	9.7	19	7.94	84.8	1.0	24,000	8.4	120	257	5.8
	"	11:45 A Sept. 7	7.9	16	8.68	87.1	4.1	110,000	8.3	100	213	4.4
	"	2:15 P Sept. 22	6.6	24	7.39	86.7	1.1	3,900	8.4	190	260	6.2
	"	1:35 P Sept. 27	7.0	19	8.83	94.4	1.1	1,500	8.2	120	254	5.5
	"	11:50 A Oct. 29	11	15	9.47	93.3	5.0	1,500	8.0	150	253	6.0
	"	1:00 P Dec. 6	14	0	12.49	85.4	1.1	91	8.3	40	247	4.9
	"	12:47 P Dec. 22	12	3	13.10	97.3	1.4	4,600	7.8	130	241	8.6
Republican River High bridge at Harlan Dam Site East of Republican City	R - 236.2	10:27 A Mar. 30	600	11	9.67	87.3	2.0	4,300	8.2	600	220	5.7
	"	8:45 A Apr. 8	480	9	10.12	87.4	2.7	9,300	8.3	600	240	6.9
	"	11:15 A Apr. 15	450	16	9.35	94.0	3.3	360	8.4	380	238	7.3
	"	11:33 A Apr. 27	325	17	9.08	93.2	4.8	1,200	8.5	400	206	8.2
	"	10:45 A May 10	390	12	10.13	93.5	3.4	9,300	8.5	450	250	10
	"	7:45 A May 24	190	17	8.43	86.6	2.7	-	8.4	180	228	9.8

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 236.2	7:35 A June 7	430	19	7.02	75.1	4.2	24,000	8.4	1,900	172	5.3
High Bridge at Harlan Dam Site east of	"	8:30 A June 16	500	22	7.33	83.0	5.1	24,000	8.2	8,000	152	3.3
Republican City	"	10:15 A June 25	2,800	21	6.71	74.7	3.0	43,000	8.0	6,300	124	3.0
	"	7:30 A July 12	1,600	23	6.34	73.0	4.2	24,000	8.1	13,000	117	2.0
	"	10:50 A July 20	970	24	7.11	83.4	4.4	93,000	8.0	5,000	156	3.4
	"	8:50 A July 30	1,000	20	3.98	43.4	2.9	150,000	7.7	23,900	125	2.3
	"	7:55 A Aug. 9	380	22	6.85	77.7	4.6	46,000	8.3	3,400	198	6.4
	"	1:55 P Sept.22	70	26	7.77	94.5	6.5	24,000	8.4	800	240	9.8
	"	1:10 P Sept.27	50	22	8.06	91.3	1.7	2,300	8.2	550	258	13
	"	11:30 A Oct. 29	190	14	9.21	88.9	5.6	24,000	8.4	700	238	9.3
	"	12:40 P Dec. 6	500	0	12.80	87.5	3.5	24,000	8.3	1,800	217	6.3
	"	12:26 P Dec. 22	310	2	12.08	87.2	1.1	930	8.3	35	247	6.7
Republican River	R - 239.8	9:50 A Mar. 30	580	10	9.86	87.0	2.2	7,500	8.2	700	226	8.5
Bridge south of Republican City	"	8:30 A Apr. 8	470	9	10.02	86.6	2.5	4,300	8.3	550	238	6.9
	"	11:25 A Apr. 15	440	16	9.21	92.6	3.1	360	8.4	400	238	7.3
	"	11:11 A Apr. 27	310	17	8.60	88.3	4.9	930	8.5	340	209	7.8
	"	10:35 A May 10	370	11	10.06	90.9	3.5	4,300	8.6	450	257	10
	"	7:30 A May 24	175	17	8.23	84.4	5.5	-	8.4	150	227	7.8
	"	7:45 A June 7	400	19	7.20	77.0	4.2	4,300	8.4	1,800	178	6.1
	"	8:55 A June 16	800	22	7.15	81.0	4.3	24,000	8.2	10,000	147	4.2
	"	11:15 A June 25	2,800	21	6.86	76.3	3.0	21,000	7.9	5,600	131	3.4
	"	7:45 A July 12	1,500	23	6.28	72.4	3.5	24,000	8.0	13,500	126	2.0
	"	11:10 A July 20	920	24	7.13	83.6	4.7	43,000	8.0	3,800	164	5.8
	"	9:30 A July 30	1,300	21	4.71	52.4	3.5	210,000	7.8	20,600	115	0.9
	"	8:25 A Aug. 9	350	22	7.20	81.6	5.2	24,000	8.3	3,200	234	7.1
	"	11:20 A Sept. 7	180	17	8.40	86.2	5.6	9,300	8.4	1,400	180	4.2
	"	1:40 P Sept.22	65	25	8.15	97.2	6.4	46,000	8.6	350	229	8.8
	"	12:35 P Sept.27	50	19	9.18	98.2	5.6	7,500	8.3	240	256	9.2
	"	11:20 A Oct.29	195	13	9.57	90.3	5.3	4,300	8.4	550	237	7.7
	"	12:20 P Dec. 6	500	0	12.64	86.5	3.7	4,300	8.2	3,600	223	5.9
	"	12:05 P Dec. 22	320	1	13.22	92.8	1.4	930	8.3	150	248	8.0
Prairie Dog Creek	R - 239.8 PDC - 0.2	10:05 A Mar. 30	16	9	9.23	79.7	3.2	1,500	8.2	800	157	4.2
Bridge South of Republican City	"	8:20 A Apr. 8	12	9	9.53	82.3	5.8	430	8.3	140	288	13
	"	11:30 A Apr. 15	12	16	9.52	95.7	7.3	230	8.3	100	288	17
	"	11:04 A Apr. 27	10	16	8.82	88.7	3.3	430	8.4	95	314	12
	"	10:25 A May 10	8	11	8.87	80.0	2.6	1,500	8.3	40	324	17
	"	7:20 A May 24	2.5	17	5.67	58.3	5.3	-	8.3	150	324	18
	"	8:00 A June 7	20	16	6.54	65.7	3.2	110,000	8.1	2,100	124	0.9
	"	9:05 A June 16	50	22	5.91	66.9	3.2	9,300	7.7	390	138	3.8
	"	11:10 A June 25	80	21	6.75	75.1	3.8	43,000	7.7	5,300	103	1.1
	"	7:50 A July 12	150	20	5.97	65.1	4.2	43,000	7.7	14,000	100	-
	"	11:20 A July 20	50	22	4.91	55.6	10.4	1,100,000	7.7	15,800	93	-
	"	9:40 A July 30	16	20	2.66	29.0	1.7	9,100	8.3	2,000	121	-

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Prairie Dog Creek	R - 239.8 PDC - 0.2	8:15 A Aug. 9	20	21	7.48	83.3	>7.5	4,300	8.5	1,000	232	15
Bridge south of Republican City	"	11:10 A Sept. 7	3	17	7.31	75.1	4.9	2,400	8.1	300	264	7.4
	"	1:25 P Sept. 22	1.5	22	8.51	96.3	6.0	2,400	8.1	260	233	11
	"	12:30 P Sept. 27	1	16	8.40	84.5	4.2	1,500	7.8	170	256	6.1
	"	11:05 A Oct. 29	0.1	12	4.23	39.0	13.6	230	7.7	95	317	7.5
	"	12:05 P Dec. 6	4.5	0	9.67	66.1	3.2	4,300	7.9	15	336	30
	"	12:00 N Dec. 22	4.5	1	13.11	92.1	1.6	240	7.9	20	324	32
Prairie Dog Creek	R - 239.8 PDC - 22.1	5:50 A May 17	5	17	5.31	55.5	2.6	1,500	8.3	35	287	12
County bridge at Woodruff	"	8:10 A May 27	6	18	6.35	66.6	2.8	-	8.3	35	313	12
	"	8:25 A June 2	250	18	5.22	54.7	3.8	-	7.8	4,000	152	1.8
	"	7:55 A June 9	12	21	5.74	63.9	2.1	-	7.7	450	139	2.4
	"	8:40 A June 17	100	19	5.23	56.0	3.4	-	7.7	8,500	100	3.2
	"	8:05 A June 23	286	19	4.91	52.6	3.4	-	7.6	5,700	105	2.8
	"	7:45 A June 30	167	20	5.91	64.4	3.7	-	7.5	5,800	102	2.0
	"	7:50 A July 8	14	23	5.77	66.5	2.4	-	7.9	700	128	3.7
	"	7:45 A July 14	30	23	5.97	68.8	2.9	-	7.7	5,400	108	14
	"	7:50 A July 21	363	21	4.46	49.6	3.4	-	7.5	17,000	117	1.8
	"	12:30 P July 28	14	25	5.96	71.2	2.0	24,000	7.8	1,000	124	6.1
	"	7:55 A Aug. 10	11	22	5.87	66.6	2.7	9,300	8.3	550	200	12
	"	8:00 A Aug. 24	4	21	5.51	61.3	2.1	4,300	7.7	1,000	132	4.8
	"	7:40 A Sept. 2	0.5	21	5.07	56.4	5.9	1,500	8.2	180	175	9.4
	"	8:30 A Sept. 29	0.8	12	7.04	64.9	3.4	1,500	7.9	170	200	8.2
	"	8:10 A Oct. 12	0	3	5.64	41.8	7.1	230	7.5	90	232	9.1
	"	8:05 A Dec. 2	3.7	-1	9.87	67.4	3.6	91	8.0	20	319	28
	"	7:55 A Dec. 10	3.5	-1	9.45	64.6	1.7	91	7.8	45	324	28
Prairie Dog Creek	R - 239.8 PDC - 47.5	8:25 A June 2	75	18	6.10	65.3	3.9	-	7.8	5,000	121	1.9
County bridge 1-1/2 miles east of Almena	"	8:30 A June 9	10	20	6.42	70.0	3.9	-	8.4	350	205	16
	"	9:15 A June 17	50	21	5.48	61.0	3.8	-	7.5	6,500	128	4.0
	"	8:40 A June 23	75	18	5.92	62.2	4.0	-	7.7	5,800	100	0.6
	"	8:25 A June 30	220	20	5.66	61.8	4.5	-	7.7	5,600	89	2.8
	"	8:25 A July 8	16	22	6.00	68.0	5.3	-	8.9	450	260	24
	"	8:25 A July 14	21	23	6.07	70.0	2.8	-	7.7	1,800	151	1.0
	"	8:30 A July 21	140	21	5.41	60.2	4.1	-	7.6	8,000	102	4.9
	"	1:00 P July 28	11	27	6.15	76.2	2.7	24,000	8.0	550	200	6.1
	"	8:30 A Aug. 10	9	19	4.51	48.3	11.5	>110,000	7.4	6,000	94	2.0
	"	8:30 A Aug. 24	4.5	20	5.60	61.1	4.0	46,000	7.9	500	248	17
	"	8:15 A Sept. 2	1	22	4.40	[illegible]	5.4	24,000	8.3	100	312	26
	"	9:00 A Sept. 29	2.5	12	8.34	76.9	>8.3	7,500	8.7	140	278	55
	"	8:45 A Oct. 12	2.2	4	7.15	54.4	6.2	4,300	7.7	30	302	35
	"	8:45 A Dec. 2	5	0	10.73	73.4	2.7	110,000	8.0	10	282	19
	"	8:30 A Dec. 10	3	-1	10.35	70.7	1.7	46,000	7.9	30	310	42

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Prairie Dog Creek Bridge - U.S. Highway No. 383 at Almena	R - 239.8 PDC - 49.6	6:50 A May 17	9	15	6.03	59.4	3.0	9,300	8.3	100	306	28
	"	8:50 A May 27	8	16	8.00	80.4	2.6	-	8.3	55	294	14
	"	9:15 A June 2	60	19	6.15	65.8	3.6	-	7.8	5,500	139	0.9
	"	8:40 A June 9	10	19	6.85	73.3	3.2	-	8.2	450	218	10
	"	9:25 A June 17	30	20	5.95	64.8	3.6	-	7.7	6,500	142	5.7
	"	8:50 A June 23	70	19	6.28	67.2	4.6	-	7.4	5,400	104	0.6
	"	8:35 A June 30	230	19	4.58	48.9	11.0	-	7.7	8,400	76	1.9
	"	8:35 A July 8	15	22	6.82	77.3	5.7	-	8.7	400	260	2.3
	"	8:35 A July 14	20	23	6.41	73.9	2.6	-	7.8	1,400	152	4.1
	"	8:40 A July 21	135	22	5.65	64.1	3.7	-	7.6	7,600	101	2.7
	"	1:10 P July 28	10	27	6.30	78.1	3.0	110,000	7.9	450	204	8.9
	"	8:40 A Aug. 10	8	21	5.14	57.2	9.2	›110,000	7.6	4,700	161	5.0
	"	8:45 A Aug. 24	4.5	21	6.80	75.7	4.1	9,300	8.1	280	242	9.2
	"	8:30 A Sept.2	1.5	22	5.92	67.0	4.9	910	8.3	95	308	15
	"	9:10 A Sept.29	2.5	10	9.48	83.6	5.8	930	6.7	90	298	56
	"	9:00 A Oct. 12	2.2	4	8.62	65.6	6.4	430	7.9	35	307	44
	"	9:00 A Dec. 2	5	0	11.21	76.7	2.0	430	8.1	10	285	25
	"	8:45 A Dec. 10	3	0	11.64	79.6	1.5	1,100	7.9	20	304	22
Prairie Dog Creek Bridge - 3 miles east of Norton - U. S. Highway No. 36	R - 239.8 PDC - 61.8	6:50 A May 17	5.2	14	6.27	60.4	4.1	24,000	8.3	40	288	20
	"	9:10 A May 27	4	16	7.62	76.6	6.0	-	8.2	60	255	11
	"	9:35 A June 2	40	19	6.12	65.5	3.9	-	7.7	3,200	147	2.6
	"	9:00 A June 9	5.5	20	6.23	68.0	4.3	-	8.1	300	233	9.0
	"	9:45 A June 17	25	20	6.25	68.2	3.9	-	7.7	5,800	107	2.3
	"	9:05 A June 23	42	18	6.50	68.3	3.3	-	7.6	5,000	104	0.6
	"	8:55 A June 30	270	20	4.86	53.0	9.5	-	7.7	9,400	104	3.4
	"	8:55 A July 8	7.5	22	6.24	70.7	5.7	-	8.7	290	279	11
	"	8:50 A July 14	10	24	5.69	66.7	3.3	-	7.9	560	198	4.8
	"	9:05 A July 21	105	21	5.76	64.2	4.3	-	7.5	7,100	101	1.3
	"	1:30 P July 28	8	28	5.98	75.5	4.1	110,000	8.1	450	215	6.3
	"	9:05 A Aug. 10	6	22	6.11	69.2	3.42	460,000	7.9	500	216	8.0
	"	9:05 A Aug. 24	4.5	20	6.29	68.6	4.18	4,300	7.9	180	270	14
	"	8:50 A Sept. 2	2	22	5.41	61.3	4.35	110,000	8.6	95	269	30
	"	9:25 A Sept.29	2.3	11	9.55	86.3	4.52	46,000	8.5	55	267	22
	"	9:20 A Oct. 12	2	4	9.88	75.1	4.85	›110,000	7.9	30	296	14
	"	9:25 A Dec. 2	4.7	0	10.39	71.0	4.40	460,000	8.0	45	274	10
	"	9:10 A Dec. 10	4	0	9.45	64.6	4.25	240,000	8.0	25	300	16
Prairie Dog Creek County bridge 2 miles east of Norton	R - 239.8 PDC - 63.5	9:45 A June 2	38	19	6.35	67.9	3.5	-	7.6	3,100	143	3.3
	"	9:10 A June 9	5.5	20	6.09	66.4	4.7	-	8.4	260	330	8.0
	"	9:55 A June 17	60	20	6.32	68.8	4.5	-	7.8	4,600	116	3.3
	"	9:15 A June 23	40	18	6.91	72.6	4.0	-	7.6	4,600	110	0.7
	"	9:55 A June 30	200	21	5.60	62.3	4.8	-	7.7	8,600	91	3.7
	"	9:05 A July 8	7	23	6.84	78.8	5.7	-	8.5	250	272	8.0
	"	9:00 A July 14	10	23	5.93	68.3	3.5	-	7.9	600	207	5.7

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Prairie Dog Creek	R - 239.8 PDC - 63.5	9:15 A July 21	100	21	6.01	66.9	4.1	-	7.6	6,800	106	0.4
County bridge 2 miles east of Norton	"	1:35 P July 28	7	29	5.60	72.1	>5.4	1,100,000	7.7	390	226	6.9
	"	9:20 A Aug. 10	6	22	6.38	72.3	4.0	240,000	8.0	600	216	4.2
	"	9:20 A Aug. 24	4.5	21	6.56	73.1	5.0	150,000	8.0	160	260	11
	"	9:10 A Sept. 2	2.5	21	5.14	57.2	>5.1	75,000	8.2	35	300	17
	"	9:35 A Sept. 29	2.3	11	9.67	87.4	>9.7	460,000	8.3	45	284	43
	"	9:30 A Oct. 12	2	5	8.80	68.7	>8.8	110,000	7.8	25	310	21
	"	9:45 A Dec. 2	4.5	0	10.91	74.6	2.6	46,000	8.1	35	266	8.5
	"	9:25 A Dec. 10	4	0	10.10	69.0	3.4	46,000	7.9	30	282	10
Prairie Dog Creek	R - 239.8 PDC - 66.0	7:30 A May 17	5.2	16	7.98	80.3	2.2	930	8.2	60	286	6.5
Bridge, U. S. Highway No. 283	"	9:22 A May 27	4	16	8.96	90.2	2.2	-	8.2	90	238	5.4
	"	9:55 A June 2	36	19	6.60	70.7	3.4	-	7.8	3,400	136	3.4
	"	9:50 A June 9	5	22	7.33	82.9	1.6	-	8.4	250	229	8.1
	"	10:05 A June 17	96	20	5.46	59.6	4.0	-	7.6	6,600	136	2.5
	"	9:45 A June 23	36	19	7.06	75.6	4.3	-	7.7	3,800	113	1.0
	"	10:20 A June 30	164	21	6.05	67.1	5.4	-	7.7	8,600	87	4.3
	"	10:10 A July 8	7	23	7.91	91.2	3.6	-	8.7	300	269	6.9
	"	9:25 A July 14	10	23	6.71	77.3	2.2	-	7.8	550	203	3.3
	"	10:55 A July 21	90	22	6.32	71.7	4.5	-	7.7	5,800	112	1.8
	"	1:55 P July 28	7	29	6.84	87.9	2.7	15,000	7.9	350	226	4.8
	"	10:25 A Aug. 10	6	23	7.17	82.7	2.6	24,000	8.3	580	217	4.8
	"	10:30 A Aug. 24	4.5	20	7.55	82.3	2.70	4,300	8.2	200	261	5.3
	"	10:10 A Sept. 2	2.7	23	7.44	85.7	3.2	9,300	8.4	70	284	7.9
	"	10:10 A Sept. 29	2.3	12	10.13	93.7	2.5	360	8.3	35	266	5.4
	"	9:45 A Oct. 12	2	5	10.37	80.9	3.9	230	8.0	25	284	6.0
	"	12:[illegible] P Dec. 2	4.3	0	12.65	86.4	5.3	230	8.1	15	259	5.7
	"	9:40 A Dec. 10	4	0	12.19	83.3	1.3	230	7.9	20	281	7.9
Prairie Dog Creek	R - 239.8 PDC - 76.0	8:00 A May 17	4	14	7.35	70.9	2.2	1,500	8.2	80	289	7.0
Bridge - north of Dellvale	"	9:50 A May 27	3	14	7.99	77.2	3.2	-	8.1	180	268	7.2
	"	10:30 A July 21	75	22	6.28	71.2	4.2	-	7.6	5,200	105	1.3
	"	10:00 A Aug. 10	5	21	6.70	74.5	1.8	15,000	8.3	500	216	4.5
	"	10:50 A Aug. 24	3	22	7.10	80.5	2.1	24,000	8.2	160	277	4.0
	"	9:50 A Sept. 2	2	21	5.86	65.1	3.2	9,300	8.1	100	284	7.8
	"	10:25 A Oct. 12	1.5	6	10.16	81.3	3.7	430	7.7	10	260	26
	"	10:30 A Dec. 2	3	0	10.54	72.2	2.3	430	7.7	15	260	5.2
Prairie Dog Creek	R - 239.8 PDC - 98.0	8:30 A May 17	2	15	8.53	84.0	3.3	2,400	8.0	100	240	8.9
Bridge - U. S. Highway No. 383 at Jennings	"	10:35 A May 27	2	21	8.14	90.6	3.5	-	8.2	200	269	8.6
Republican River	R - 245.0	8:30 A June 7	380	20	7.42	80.9	4.5	1,500	8.4	1,700	185	6.3
No bridge - 3 miles west [illegible]publican City	"	9:40 A June 16	1,000	24	7.53	88.3	4.5	15,000	8.2	6,300	159	4.2
	"	11:40 A June 25	2,900	22	6.86	77.7	2.9	93,000	7.8	5,900	134	3.6
	"	8:25 A July 12	1,400	24	6.46	75.7	3.5	24,000	8.1	13,500	132	2.7

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 245.0	11:40 A July 20	870	24	7.25	85.0	4.2	93,000	7.9	4,500	164	4.0
No bridge - 3 miles west of Republican	"	10:00 A July 30	1,600	20	4.19	45.7	3.0	460,000	7.9	[illegible],300	114	0.8
City	"	10:50 A Aug. 9	320	24	7.23	84.8	4.9	7,500	8.3	2,000	217	8.6
	"	1:05 P Sept.22	60	25	7.90	94.3	6.8	7,500	8.6	360	229	8.5
	"	12:15 P Sept.27	45	17	9.05	92.8	5.6	4,300	8.3	300	249	7.8
	"	10:45 A Oct. 29	200	12	9.60	88.5	5.0	9,300	8.3	650	237	8.2
	"	11:50 A Dec. 6	490	0	12.89	88.1	3.4	4,300	8.3	1,900	222	6.3
	"	11:30 A Dec. 22	335	2	13.03	94.2	1.0	2,400	8.3	130	249	8.2
Republican River	R - 247.4	9:10 A Mar. 30	520	10	9.61	84.8	2.1	2,400	8.2	650	220	5.7
At Alma - Bridge U. S. Highway No. 183	"	7:10 A Apr. 8	450	8	10.05	84.7	2.7	2,800	8.3	450	232	7.8
and 383	"	2:10 P Apr. 15	430	19	9.25	98.9	3.8	910	8.3	450	240	6.9
	"	10:34 A Apr. 27	300	17	9.15	94.0	5.6	2,400	8.4	360	211	7.8
	"	8:40 A May 10	350	10	10.07	88.8	3.6	46,000	8.5	400	256	9.0
	"	6:40 A May 24	160	17	7.51	77.2	5.5	-	8.4	160	222	6.4
	"	8:45 A June 7	370	20	7.24	79.0	5.4	9,300	8.4	1,800	188	6.4
	"	10:10 A June 16	2,000	23	6.60	76.1	4.0	46,000	8.3	5,500	170	5.3
	"	11:50 A June 25	2,900	21	6.64	73.9	3.2	93,000	7.9	6,200	124	2.8
	"	8:35 A July 12	1,400	24	6.33	74.2	4.2	15,000	7.9	13,500	128	2.3
	"	12:00 N July 20	830	24	6.94	81.4	4.2	39,000	8.0	4,500	163	4.2
	"	11:05 A July 30	1,800	20	4.30	46.9	3.0	460,000	8.1	19,500	126	2.7
	"	10:35 A Aug. 9	310	24	7.07	83.0	6.6	110,000	8.3	2,600	211	9.1
	"	10:10 A Sept. 7	180	17	7.95	81.6	6.2	24,000	8.4	1,400	189	5.8
	"	12:50 P Sept.22	60	25	8.48	101.2	6.7	360	8.6	380	232	8.6
	"	11:55 A Sept.27	45	16	9.41	94.7	7.5	>11,000	8.3	250	243	8.1
	"	10:30 A Oct. 29	200	12	9.60	88.5	4.2	4,300	8.3	600	239	8.1
	"	11:35 A Dec. 6	490	0	12.83	87.7	3.3	15,000	8.2	1,900	214	6.1
	"	11:15 A Dec. 22	340	2	13.17	95.0	0.8	930	8.3	120	246	8.9
Republican River	R - 251.6	9:00 A June 7	360	21	7.34	81.6	5.1	9,300	8.4	1,500	185	5.5
No bridge - 2 miles east and 2 miles	"	10:40 A June 16	3,000	24	7.27	85.2	4.3	110,000	8.2	5,600	160	4.3
south of Orleans	"	12:10 P June 25	3,000	21	6.66	74.1	3.1	43,000	7.7	6,800	131	1.9
	"	9:05 A July 12	1,300	24	6.47	75.8	3.8	24,000	8.0	14,000	132	3.0
	"	12:35 P July 20	800	25	7.00	83.5	3.9	23,000	8.1	3,900	182	3.7
	"	11:40 A July 30	2,000	20	4.76	51.9	3.0	93,000	8.0	18,800	134	0.7
	"	10:15 A Aug. 9	300	22	7.25	82.2	5.0	24,000	8.3	2,400	215	8.3
	"	9:45 A Sept. 7	170	17	7.95	81.6	6.2	24,000	8.4	1,400	196	5.7
	"	12:25 P Sept.22	55	23	7.91	91.2	6.0	2,300	8.6	400	228	8.4
	"	11:35 A Sept.27	45	15	9.90	97.4	5.4	9,300	8.4	300	242	8.0
	"	2:25 P Oct. 11	55	13	10.62	100.2	5.2	930	8.5	210	267	8.7
	"	10:15 A Oct. 29	205	12	9.30	85.7	4.5	7,500	8.3	650	228	7.2
	"	11:10 A Dec. 6	490	0	12.86	87.9	3.4	4,300	8.3	2,200	210	6.0
	"	11:00 A Dec. 22	345	1	13.09	91.9	1.6	1,500	8.4	90	241	8.3

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 255.0	10:15 A Mar. 31	510	-	10.72	-	2.6	4,300	8.2	900	224	5.8
Bridge 1-1/2 miles south of Orleans	"	7:30 A Apr. 8	430	8	10.02	84.6	2.6	1,500	8.3	450	233	7.6
	"	1:08 P Apr. 15	410	18	9.32	97.8	3.6	910	8.3	380	232	6.6
	"	10:10 A Apr. 27	280	15	8.71	85.8	5.4	1,500	8.4	300	208	8.4
	"	9:30 A May 10	330	10	10.25	90.4	3.6	2,400	8.6	390	251	9.0
	"	11:15 A May 26	460	19	7.61	81.4	6.7	-	7.9	3,500	202	8.5
	"	9:30 A June 7	350	21	7.76	86.3	6.0	1,500	8.4	1,200	195	6.7
	"	11:00 A June 16	4,000	24	5.35	62.7	7.8	24,000	8.1	12,000	164	3.7
	"	9:25 A July 12	1,300	24	6.78	79.5	4.4	24,000	8.1	14,000	144	3.3
	"	1:15 P July 20	780	24	6.99	81.9	4.0	23,000	8.1	4,700	152	5.0
	"	12:00 N July 30	2,200	20	4.55	49.6	2.9	93,000	8.1	23,900	133	0.7
	"	9:40 A Aug. 9	290	23	7.29	84.1	4.5	24,000	8.5	2,400	202	7.8
	"	9:00 A Sept.7	170	18	7.86	82.4	6.2	15,000	8.4	1,300	192	5.5
	"	11:50 A Sept.22	50	23	8.11	93.4	6.4	910	8.5	450	225	7.9
	"	11:15 A Sept.27	45	16	9.72	97.7	5.8	2,400	8.4	300	231	7.0
	"	2:05 P Oct. 11	55	14	11.15	107.5	4.9	430	8.5	230	255	8.3
	"	9:50 A Oct. 29	210	12	9.61	88.7	5.0	11,000	8.3	650	229	7.8
	"	10:50 A Dec. 6	490	0	12.73	87.0	4.2	46,000	8.2	2,500	225	6.8
	"	10:40 A Dec. 22	350	1	12.48	87.6	1.2	930	8.3	65	240	8.5
Sappa Creek	R - 258.0 S.C.-1.0	9:55 A Mar 31	29	-	10.21	-	2.6	1,500	8.2	450	221	6.1
Bridge 3 miles west of Orleans	"	11:25 A Apr. 7	23	13	8.88	83.8	3.2	2,400	8.2	190	286	6.1
	"	11:05 A Apr. 19	18	18	9.04	94.8	7.0	930	8.3	180	326	12
	"	9:30 A Apr. 27	16	14	8.21	79.2	5.2	930	8.4	200	335	13
	"	9:05 A May 10	14	11	9.41	84.8	4.8	930	8.4	110	375	14
	"	10:50 A May 26	4	18	8.58	90.0	7.8	-	8.3	180	360	13
	"	9:55 A June 7	80	19	6.32	67.6	4.2	>11,000	8.2	2,600	129	4.1
	"	11:40 A June 16	65	23	6.55	75.5	4.1	24,000	8.2	1,400	168	5.9
	"	12:50 P June 25	1,000	20	6.20	67.6	3.6	120,000	7.7	5,200	93	1.0
	"	9:55 A July 12	310	22	6.25	70.8	4.2	9,300	8.0	13,500	165	4.3
	"	2:00 P July 20	150	23	6.79	78.2	4.6	43,000	7.9	7,200	116	2.7
	"	12:45 P July 30	95	21	5.99	66.6	3.5	43,000	8.1	5,300	120	2.0
	"	9:10 A Aug. 9	90	20	6.65	72.6	5.0	4,300	7.8	4,000	179	8.9
	"	8:20 A Sept. 7	20	18	7.53	79.0	4.1	11,000	7.9	900	189	4.3
	"	11:10 A Sept. 22	5	19	7.48	80.1	2.8	9,300	7.9	450	212	5.2
	"	10:50 A Sept.27	2.5	12	9.23	85.2	3.4	360	8.0	250	252	5.8
	"	8:50 A Oct. 29	0.05	12	3.00	27.7	21.9	750	7.5	100	294	8.0
	"	10:20 A Dec. 6	5	0	11.18	76.4	4.1	<360	8.3	140	356	12
	"	10:02 A Dec. 22	6	1	12.40	87.1	2.3	93	7.9	30	353	13
Sappa Creek	R - 258.0 S.C.-7.9	9:15 A Mar. 31	29	-	10.03	-	3.3	930	8.2	370	229	7.8
County Bridge - South of Stamford	"	11:05 A Apr. 7	23	12	9.38	86.6	3.5	2,400	8.2	160	281	9.6
	"	10:50 A Apr. 19	18	18	8.70	91.2	6.7	430	8.3	110	317	12
	"	2:35 P Apr. 26	16	18	9.77	102.3	9.4	230	8.3	120	340	12
	"	2:10 P May 3	15	17	9.60	98.6	>9.3	2,400	8.3	170	347	12

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Sappa Creek	R - 258.0 S.C.-7.9	11:15 A May 13	12	15	9.75	96.0	3.1	150	8.4	70	360	9.8
County bridge, south of Stamford	"	10:35 A May 26	3.5	16	9.09	91.4	8.7	-	8.3	150	340	13
	"	6:35 A June 10	35	21	6.38	71.0	5.0	-	8.3	1,200	149	3.5
	"	7:05 A June 18	15	19	6.85	73.3	3.5	24,000	7.9	3,700	128	0.3
	"	6:35 A June 28	1,350	19	5.90	63.1	3.9	460,000	7.7	14,000	92	1.2
	"	5:30 A July 13	250	22	6.03	68.3	4.0	43,000	7.6	14,000	144	5.6
	"	6:55 A July 27	100	22	6.04	68.4	3.5	15,000	8.2	3,900	145	5.3
	"	7:00 A Aug. 3	55	20	6.50	70.9	3.3	23,000	8.1	1,200	190	5.6
	"	8:00 A Sept. 7	18	17	7.29	74.8	4.6	46,000	7.9	1,200	178	3.7
	"	10:55 A Sept. 22	4.5	19	7.36	78.8	3.3	3,500	7.8	450	208	5.0
	"	10:35 A Sept. 27	2	11	8.56	77.3	3.5	2,300	7.8	270	235	5.3
	"	8:30 A Oct. 29	0.05	11	1.00	9.0	>28.2	4,600	7.6	100	336	8.2
	"	9:55 A Dec. 6	5	0	9.92	67.8	4.3	<360	8.3	45	328	11
	"	9:45 A Dec. 22	5.5	1	10.35	72.7	2.2	210	7.8	25	342	12
Beaver Creek	R - 258.0 S.C.-12.3	8:30 A Mar. 31	9	7	10.44	85.9	2.5	24,000	8.2	200	259	10
Bridge 3 miles west of Stamford	Be.C.-1.2 "	10:35 A Apr. 7	8	11	9.42	85.2	2.7	2,300	8.4	65	288	12
	"	10:15 A Apr. 19	7	17	8.62	88.4	4.3	1,500	8.3	75	289	14
	"	2:05 P Apr. 26	8	17	10.56	108.4	10.1	<360	8.4	140	321	15
	"	1:00 P May 3	7	14	9.11	88.0	7.2	9,300	8.3	90	308	13
	"	11:30 A May 13	13	16	8.67	87.2	3.4	2,000	8.3	100	340	14
	"	10:10 A May 26	3	15	9.32	91.8	7.3	-	8.3	180	334	16
	"	6:20 A June 10	20	21	6.14	68.3	5.0	46,000	8.3	2,000	161	7.4
	"	6:55 A June 18	5	19	6.82	72.9	2.7	9,100	8.2	700	182	5.6
	"	6:10 A June 28	700	18	5.95	62.4	2.7	43,000	7.7	4,400	92	0.5
	"	6:10 A July 13	125	24	6.12	71.7	9.0	43,000	8.1	12,500	144	3.6
	"	7:35 A July 27	55	24	6.11	71.6	3.6	93,000	8.1	4,400	156	3.7
Beaver Creek	R - 258.0 S.C.-12.3	5:35 A June 10	18	19	7.15	76.5	4.0	-	8.2	1,600	210	9.1
County bridge 3 miles east of Beaver City	Be.C.-12.0 "	6:15 A June 18	4	19	6.85	73.3	3.3	43,000	8.3	500	224	8.2
	"	5:30 A June 28	710	20	5.94	64.8	4.5	930,000	7.7	9,000	85	0.4
	"	6:35 A July 13	130	22	6.30	71.3	4.9	43,000	8.1	11,000	223	10
	"	7:55 A July 27	200	22	6.61	74.9	4.0	43,000	8.0	4,300	172	4.2
	"	8:30 A Aug. 3	28	20	6.99	76.2	3.1	43,000	8.2	1,000	212	5.2
Beaver Creek	R - 258.0 S.C.-12.3	5:20 A June 10	17	19	6.70	71.7	4.0	-	8.3	1,700	197	8.2
County bridge 1-1/2 miles east of Beaver City	Be.C.-15.0 "	6:05 A June 18	4	19	7.21	77.1	2.6	9,300	8.3	500	222	7.9
	"	5:15 A June 28	710	20	5.81	63.4	4.3	93,000	7.7	5,400	89	0.4
	"	7:00 A July 13	130	22	6.53	74.0	4.5	43,000	8.1	11,000	215	8.9
	"	8:20 A July 27	200	22	6.17	69.9	5.0	23,000	8.0	5,400	136	3.2
	"	8:45 A Aug. 3	27	20	6.66	72.6	2.3	3,600	8.2	1,000	214	5.6
Beaver Creek	R - 258.0 S.C.-12.3	4:50 A June 10	16	21	-	-	2.5	24,000	8.4	55	290	13
Bridge State Highway No. 89, Beaver City	Be.C.-16.0 "	5:55 A June 18	4	19	7.09	75.8	2.3	4,300	8.2	450	212	6.8
	"	4:50 A June 28	710	19	6.34	67.8	4.5	460,000	7.7	5,200	92	0.4

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Beaver Creek	R - 258.0 S.C.-12.3	7:15 A July 13	130	22	6.67	75.5	4.9	15,000	8.1	11,000	221	8.5
Bridge, State Highway No. 89, Beaver City	Be.C.-16.0 "	8:35 A July 27	200	22	6.13	69.4	4.4	43,000	8.1	4,500	150	2.4
	"	8:55 A Aug. 3	27	20	6.89	75.1	2.8	9,100	8.2	1,000	213	5.4
Beaver Creek	R - 258.0 S.C.-12.3	6:05 A Mar. 30	285	19	5.26	56.3	3.6	240,000	7.9	18,000	124	1.4
Bridge north of Cedar Bluff, U.S.	Be.C.-99.5 "	6:50 A July 9	80	19	4.72	50.5	11.9	43,000	8.4	500	205	7.8
Highway No. 83	"	9:20 A July 15	203	19	3.62	38.7	8.7	430,000	7.7	17,300	116	2.6
	"	7:50 A July 21	172	22	6.79	76.9	5.1	240,000	7.9	8,000	144	3.7
	"	6:45 A July 29	25	22	5.55	62.9	2.6	24,000	8.3	800	202	6.2
	"	7:30 A Aug. 4	18	18	6.57	68.9	3.5	9,100	8.2	550	269	12
	"	7:00 A Dec. 13	1	0	1.94	13.3	14.5	<300	7.9	20	443	25
Beaver Creek	R - 258.0 S.C.-12.3	4:35 P May 27	4	19	5.08	54.4	4.6	-	8.0	210	269	12
County bridge - 2 miles east and 1-1/2	Be.C.-131.5 "	10:55 A June 3	6	20	6.29	68.6	3.6	9,300	8.2	290	215	13
miles north of Atwood	"	7:30 A June 14	0.1	17	5.26	54.0	3.9	9,300	8.3	60	388	28
	"	7:20 A June 22	76	17	6.06	62.2	5.0	110,000	7.9	1,200	178	6.3
	"	7:35 A June 30	132	19	6.00	64.2	4.6	43,000	7.3	2,800	162	6.1
	"	11:00 A July 15	19	21	6.07	67.5	3.2	93,000	8.1	280	266	12
	"	9:45 A July 21	58	22	6.61	74.9	4.1	43,000	8.1	2,000	151	3.6
	"	8:25 A July 29	23	22	5.60	63.4	2.6	24,000	8.2	270	229	8.0
	"	9:00 A Aug. 4	42	19	5.90	63.1	5.2	93,000	7.7	2,500	161	7.1
	"	6:00 A Aug. 20	15	20	6.25	68.2	3.1	-	8.0	400	195	5.6
	"	7:15 A Aug. 30	5	19	6.55	70.0	4.4	110,000	7.9	700	224	9.9
	"	8:20 A Oct. 20	0.1	6	1.88	15.1	11.3	9,300	7.9	20	434	34
	"	2:50 P Dec. 15	0.2	0	6.45	44.1	3.2	36	7.5	25	412	32
Beaver Creek	R 258.0 S.C.-12.3	11:40 A May 17	1.5	19	3.79	40.7	3.4	9,300	8.2	75	321	14
County bridge 1/2 mile east of Atwood	Be.C.-134.5 "	3:15 P May 27	4	19	6.34	67.8	3.3	-	8.3	150	289	13
	"	11:10 A June 3	6	20	4.82	52.6	5.2	43,000	8.1	220	219	14
	"	7:10 A June 14	0.1	18	1.80	18.9	4.0	43,000	8.1	30	398	23
	"	7:40 A June 22	71	17	7.30	74.9	5.3	110,000	7.9	1,500	168	6.2
	"	8:00 A June 30	125	19	6.48	69.3	4.3	43,000	8.1	2,800	163	6.5
	"	11:15 A July 15	19	22	5.70	64.6	3.9	93,000	8.1	210	252	11
	"	10:00 A July 21	55	22	5.75	65.1	2.5	21,000	8.1	1,100	153	3.3
	"	8:40 A July 29	23	23	5.18	59.7	2.8	43,000	8.1	210	222	6.4
	"	9:20 A Aug. 4	39	18	5.72	60.0	5.1	1,100,000	7.3	12,000	112	1.0
	"	6:15 A Aug. 20	15	20	5.77	63.1	3.5	-	8.0	350	192	5.9
	"	7:30 A Aug. 30	5	20	4.80	52.3	3.4	>110,000	7.7	280	248	13
	"	8:05 A Oct. 20	0.1	6	0.71	5.7	47.0	2,300	7.8	45	437	42
South Beaver Creek	R-258.0 S.C.-12.3	11:53 A May 17	1	20	5.43	59.3	2.2	2,400	8.3	150	295	9.3
Entrance to Atwood Lake - 1/2 mile west	Be.C.-135.5 S.Be.C.-1.2	2:50 P May 27	3	19	7.24	77.4	3.3	-	8.1	130	255	16
of Atwood on U.S. Highway No. 36	"	11:20 A June 3	4	21	6.49	72.2	2.8	4,300	8.0	210	201	9.8
	"	8:10 A June 14	1	20	4.17	45.5	4.0	9,300	8.2	150	336	15
	"	8:15 A June 22	60	16	6.43	64.6	3.9	9,300	8.3	400	296	14

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
South Beaver Creek	R - 258.0 S.C.-12.3	8:35 A June 30	100	18	6.21	65.1	4.0	24,000	8.0	2,600	225	7.8
Entrance to Atwood Lake - 1/2 mile west of Atwood on U. S. Highway No. 36	Be.C.-135.5 S.Be.C.-1.2	9:05 A July 9	25	20	6.36	69.4	2.8	4,300	8.4	550	303	21
	"	11:45 A July 15	15	21	5.91	65.7	3.2	4,300	8.2	300	300	12
	"	10:25 A July 21	45	23	6.19	71.3	4.4	24,000	8.0	1,600	179	4.8
	"	9:10 A July 29	18	21	5.01	55.7	2.3	9,300	8.1	330	273	7.8
	"	9:45 A Aug. 4	16	18	5.96	62.5	3.4	46,000	8.1	350	249	8.9
	"	6:30 A Aug. 20	12	21	5.19	57.8	1.7	910	8.4	380	291	9.0
	"	6:40 A Aug. 30	4	19	4.12	44.2	7.2	2,400	8.2	340	301	11
	"	2:25 P Dec. 15	0.1	0	9.06	61.9	1.6	<30	7.7	40	299	12
North Beaver Creek	R - 258.0 S.C.-12.3	4:15 P May 27	1	25	6.38	76.3	3.8	-	8.2	200	249	8.4
Bridge - State Highway No. 25 - 1 mile north of Atwood	Be.C.-135.5 N.Be.C.-1.0	11:45 A June 3	2	21	3.98	44.3	2.3	4,300	8.0	290	252	11
	"	7:50 A June 14	0.1	17	6.69	68.7	3.7	9,300	8.1	170	348	23
	"	8:00 A June 22	11	16	7.02	70.6	5.0	110,000	7.9	2,400	145	4.1
	"	8:25 A June 30	25	17	6.53	67.0	3.6	93,000	8.1	2,600	168	7.7
	"	8:55 A July 9	4	21	5.29	58.8	3.5	7,500	8.4	1,100	258	9.2
	"	11:30 A July 15	3	23	6.27	72.2	2.2	24,000	8.0	280	256	12
	"	10:15 A July 21	10	23	6.30	72.6	1.9	43,000	7.7	1,300	136	2.6
	"	8:55 A July 29	4	23	6.03	69.5	2.7	9,300	8.5	220	308	18
	"	9:35 A Aug. 4	10	15	6.40	[illegible]	5.6	460,000	7.7	12,000	94	1.4
	"	6:40 A Aug. 20	3	21	6.19	68.8	1.6	9,300	7.9	800	160	6.0
	"	6:25 A Aug. 30	1	17	5.23	53.7	3.6	4,300	7.6	900	183	12
	"	2:35 P Dec. 15	0.1	2	9.29	67.1	5.0	36	7.4	10	432	41
Sappa Creek	R -258.0 S.C.-13.2	8:45 A Mar. 31	6	-	10.39	-	2.6	24,000	8.2	240	259	10
2-1/2 miles west and 1-1/2 miles south of Stamford	"	10:45 A Apr. 7	6	12	9.34	86.2	3.1	9,300	8.4	90	295	12
	"	10:35 A Apr. 19	7	17	8.42	86.5	7.8	720	8.3	120	322	13
	"	2:20 P Apr. 26	5	18	9.91	103.8	>8.8	<360	8.3	150	340	13
	"	1:40 P May 3	6	16	8.80	88.5	>8.8	4,300	8.3	140	344	12
	"	11:45 A May 13	5	16	9.14	91.8	3.0	360	8.4	50	384	11
	"	10:20 A May 26	7	15	7.39	72.8	7.1	-	8.3	160	243	14
	"	6:05 A June 10	58	20	-	-	6.2	7,500	8.3	1,400	145	3.5
	"	6:45 A June 18	25	19	6.76	72.3	3.4	15,000	7.9	4,200	111	0.4
	"	5:55 A July 13	50	22	6.25	70.8	4.1	43,000	7.7	14,500	115	1.7
	"	7:20 A July 27	90	22	6.66	75.4	3.2	15,000	8.1	2,000	142	6.6
Sappa Creek	R - 258.0 S.C.-97.3	9:25 A June 3	16	19	6.76	72.3	4.4	15,000	8.0	1,500	141	7.6
County bridge 2 miles east and 1 mile north of Oberlin	"	6:25 A June 14	2	19	6.01	64.3	6.1	9,300	7.9	320	216	9.6
	"	5:40 A June 22	25	18	7.14	74.8	2.8	7,500	8.2	320	170	5.4
	"	5:00 A June 30	75	20	6.60	72.0	3.2	15,000	7.7	1,200	119	5.5
	"	8:30 A July 21	15	23	5.67	65.3	2.9	15,000	8.1	1,400	133	3.5
	"	7:10 A July 29	10	21	4.95	55.1	3.0	2,300	8.3	300	251	8.0
	"	8:00 A Aug. 4	250	18	6.01	63.0	4.9	43,000	7.7	2,100	113	2.0
	"	8:00 A Aug. 20	14	20	6.10	66.5	2.4	9,300	7.7	390	200	6.4
	"	8:45 A Aug. 30	6	21	5.46	61.0	3.7	1,500	7.8	340	296	13

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Sappa Creek County bridge 2 miles east and 1 mile north of Oberlin	R - 258.0 S.C.-97.3	9:10 A Oct. 20	4	9	3.54	30.6	12.6	430	7.6	15	544	18
	"	8:05 A Dec. 13	2	1	5.51	38.7	0.7	280	7.6	20	535	18
Sappa Creek Bridge - U.S.Highway No. 36, 1/2 mile east of Oberlin	R - 258.0 S.C.-100.7	12:50 P May 17	0.2	19	5.27	56.4	4.7	91	8.2	55	318	36
	"	5:35 P May 27	0	19	0.00	0.00	6.8	-	7.7	250	197	15
	"	9:40 A June 3	16	19	5.66	60.5	2.9	46,000	8.3	400	216	15
	"	6:10 A June 14	3	18	3.96	41.5	5.8	24,000	7.9	260	297	15
	"	6:05 A June 22	8	17	6.20	63.7	5.9	460,000	8.2	1,900	283	17
	"	5:20 A June 30	83	19	5.98	64.0	2.9	240,000	7.9	11,500	146	5.4
	"	7:55 A July 9	25	20	4.66	50.8	10.9	240,000	8.2	550	174	10
	"	9:50 A July 15	42	18	5.23	54.8	8.6	3,900	7.9	19,300	78	5.2
	"	8:45 A July 21	168	23	5.69	65.6	4.1	93,000	7.7	5,300	100	1.4
	"	7:25 A July 29	10	21	4.99	55.5	2.5	9,300	8.5	280	321	14
	"	8:10 A Aug. 4	330	18	5.32	55.8	4.6	93,000	7.7	3,400	83	1.7
	"	8:15 A Aug. 20	14	20	6.33	69.0	2.8	9,300	8.3	390	256	11
	"	8:25 A Aug. 30	6	21	4.10	45.7	6.9	46,000	8.4	330	356	27
	"	9:25 A Oct.20	4	7	0.0	0.0	22.8	9,300	7.7	45	421	71
	"	7:45 A Dec.13	2	0	9.60	65.6	2.3	46,000	8.0	15	348	36
Sappa Creek Bridge at Oberlin, U. S. Highway No. 83	R - 258.0 S.C.-103.2	12:40 P May 17	0.2	24	10.42	122.3	4.8	24,000	8.3	70	304	10
	"	5:25 P May 27	0	25	4.43	52.9	5.9	-	8.0	270	237	9.4
	"	10:00 A June 3	14	18	6.58	69.0	3.7	24,000	8.2	390	236	17
	"	5:55 A June 14	3	18	6.45	67.6	3.5	2,300	7.9	170	342	18
	"	6:15 A June 22	9	17	5.78	59.3	4.9	110,000	8.3	2,700	250	14
	"	5:40 A June 30	77	19	6.32	67.6	5.3	93,000	7.9	5,400	152	6.0
	"	8:15 A July 9	19	20	7.03	76.7	3.2	4,300	8.4	600	354	20
	"	10:15 A July 15	22	18	5.28	55.3	9.5	93,000	7.8	4,700	107	3.6
	"	9:05 A July 21	178	23	5.56	64.1	3.8	43,000	7.7	4,400	102	1.7
	"	7:40 A July 29	10	21	6.26	69.6	2.9	4,300	8.5	450	326	16
	"	8:25 A Aug. 4	178	17	5.42	55.6	4.8	23,000	7.7	3,200	84	0.4
	"	8:30 A Aug. 20	14	21	7.08	78.8	2.9	24,000	8.2	650	262	11
	"	9:15 A Aug. 30	5	20	7.90	86.2	5.0	9,300	8.4	280	335	19
	"	9:50 A Oct. 20	4	6	5.35	42.9	>8.0	910	7.7	30	393	20
	"	8:30 A Dec. 13	2	0	8.59	58.7	2.1	4,600	8.0	20	343	21
Republican River On route 89, 2½ miles west of Orleans	R - 260.0	9:30 A Mar. 31	470	-	10.91	-	2.5	4,300	8.2	800	230	5.3
	"	7:50 A Apr. 8	398	8	10.18	85.8	3.0	4,300	8.3	450	230	7.6
	"	1:30 P Apr. 15	378	18	9.22	96.6	3.1	2,100	8.4	380	232	7.1
	"	9:53 A Apr. 27	256	15	8.69	85.5	4.5	4,300	8.4	320	207	8.1
	"	9:15 A May 10	308	10	10.21	90.2	3.2	2,300	8.5	390	265	9.4
	"	11:00 A May 26	488	19	7.44	79.6	6.2	-	8.1	4,000	189	7.3
	"	9:45 A June 7	256	22	7.90	89.5	5.4	4,300	8.4	1,100	183	8.0
	"	11:30 A June 16	4,560	23	3.79	43.7	8.6	110,000	8.2	16,000	178	5.8
	"	12:40 P June 25	1,900	22	6.92	78.4	3.0	93,000	8.0	7,900	137	4.2
	"	9:45 A July 12	965	25	6.95	82.9	4.1	9,300	8.1	13,000	159	4.8

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 260.0	1:45 P July 20	615	24	7.11	83.4	3.7	23,000	8.1	3,000	164	4.1
On route No. 89, 2½ miles west of Orleans	"	12:30 P July 30	2,100	20	5.39	58.8	3.8	93,000	8.0	23,900	147	0.7
	"	9:25 A Aug. 9	185	22	8.02	90.8	5.8	9,300	8.7	1,400	230	7.6
	"	8:40 A Sept. 7	145	17	7.91	81.3	5.8	4,300	8.4	1,500	184	5.4
	"	11:30 A Sept.22	44	23	8.05	92.7	5.5	4,300	8.6	450	217	8.0
	"	11:00 A Sept.27	41	16	9.73	97.8	5.8	4,300	8.5	360	223	7.9
	"	1:50 P Oct.11	52	13	10.65	100.2	4.4	430	8.5	230	257	8.0
	"	9:05 A Oct. 29	207	11	9.47	85.5	4.4	46,000	8.4	800	227	8.0
	"	10:35 A Dec. 6	480	0	12.84	87.8	4.0	24,000	8.3	2,200	227	6.5
	"	10:15 A Dec. 22	350	0	12.73	87.1	1.4	930	8.3	60	239	8.4
Republican River	R - 272.4	10:55 A May 13	240	17	9.62	98.8	3.1	430	8.4	270	244	6.4
1½ miles east and 1 mile south of	"	9:55 A May 26	430	18	7.80	81.9	6.1	-	8.1	6,000	158	5.7
Oxford (no bridge)	"	7:35 A June 10	220	21	6.63	73.7	6.4	-	8.4	650	190	11
	"	7:30 A June 18	1,900	18	6.66	69.8	4.1	240,000	8.1	15,500	159	3.2
	"	7:15 A June 28	10,000	19	5.74	61.4	4.1	240,000	7.7	15,500	136	2.7
	"	8:25 A July 13	650	24	7.02	82.3	2.9	3,600	8.3	6,000	172	4.5
	"	9:55 A July 27	280	24	6.81	79.8	6.2	23,000	8.2	550	196	8.7
	"	9:45 A Aug. 3	190	20	7.50	81.8	3.6	24,000	8.3	1,100	188	5.0
	"	7:30 A Sept. 7	130	16	8.00	80.4	5.8	24,000	8.4	1,200	162	5.0
	"	10:30 A Sept. 22	50	21	8.00	89.1	6.1	46,000	8.6	450	204	7.1
	"	10:10 A Sept.27	55	12	10.21	94.3	6.1	2,300	8.5	370	221	7.8
	"	1:20 P Oct. 11	60	12	10.67	98.4	4.9	430	8.5	450	254	8.9
	"	9:35 A Dec. 6	440	0	12.81	87.6	3.2	24,000	8.3	1,600	226	5.5
	"	9:10 A Dec. 22	360	1	12.72	89.4	1.2	4,600	8.3	290	231	7.0
Republican River	R - 283.6	7:55 A Mar. 31	500	5	10.80	84.4	2.8	9,300	8.2	650	224	6.2
Pedestrian Bridge - 3/4 mile south of	"	10:05 A Apr. 7	385	11	10.05	90.9	3.0	2,300	8.4	370	233	5.3
Edison	"	9:45 A Apr. 19	335	17	9.42	96.8	3.5	1,500	8.5	320	213	7.3
	"	1:40 P Apr. 26	280	18	8.64	90.6	5.4	<360	8.4	260	220	6.4
	"	12:10 P May 3	300	16	10.00	100.4	5.8	1,500	8.3	250	192	5.7
	"	10:35 A May 13	250	16	9.85	99.0	3.0	2,400	8.4	270	248	5.7
	"	9:40 A May 26	400	17	8.08	83.1	5.9	-	8.1	5,500	154	4.5
	"	8:00 A June 10	250	22	7.53	85.3	7.2	11,000	8.3	1,200	181	8.6
	"	8:40 A June 18	1,600	19	6.74	72.1	4.7	150,000	8.1	15,000	157	4.4
	"	8:45 A July 13	570	24	7.40	86.8	3.4	23,000	8.3	6,500	178	4.1
	"	10:30 A July 27	320	24	5.30	62.1	9.7	93,000	8.0	4,300	173	7.5
	"	10:45 A Aug. 3	170	19	7.35	78.6	3.4	9,100	8.3	1,000	198	6.1
	"	10:05 A Sept.22	50	20	8.47	92.4	6.2	2,300	8.8	400	220	6.8
	"	9:45 A Sept. 27	60	13	10.81	102.0	5.6	4,300	3.5	350	218	6.3
	"	12:50 P Oct. 11	65	11	11.36	102.5	6.7	1,500	8.5	400	249	10
	"	8:00 A Oct. 29	215	11	9.60	86.7	4.5	24,000	8.3	600	222	8.0
	"	9:05 A Dec. 6	420	0	12.63	86.4	3.7	15,000	8.3	1,400	223	6.8
	"	8:30 A Dec. 22	365	1	11.66	81.9	1.3	24,000	8.3	350	224	7.9

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 289.0	9:50 A Apr. 7	390	11	9.91	89.5	2.7	2,300	8.4	370	229	5.7
2 miles west of Edison - No bridge	"	9:30 A Apr. 19	330	17	9.45	97.1	4.0	2,400	8.5	350	214	7.7
	"	1:20 P Apr. 26	300	18	8.93	93.6	5.0	930	8.4	300	214	6.3
	"	10:35 A May 13	260	16	9.33	93.7	3.0	4,600	8.4	270	242	5.8
	"	9:30 A May 26	390	16	8.23	82.7	6.1	-	8.1	5,500	153	3.9
	"	10:05 A June 18	1,400	22	7.05	79.8	4.4	75,000	8.1	13,000	151	3.1
	"	10:00 A July 13	500	29	6.37	82.0	1.6	23,000	8.2	6,000	196	5.0
	"	11:00 A July 27	360	24	6.09	71.4	5.6	460,000	7.4	10,000	98	1.8
	"	12:30 P Oct. 11	70	12	11.36	104.7	5.8	930	8.4	370	249	8.1
	"	8:00 A Dec. 22	365	0	8.68	59.3	0.9	24,000	8.3	350	244	7.4
Republican River	R - 292.6	6:45 A Mar.31	530	4	10.80	82.1	2.8	46,000	8.2	800	222	7.0
Bridge - U.S. Highway #283, South of Arapahoe	"	9:25 A Apr. 7	390	12	9.82	90.6	3.0	3,600	8.4	370	228	6.3
	"	9:10 A Apr. 19	330	17	9.33	95.9	3.9	4,300	8.5	290	214	7.2
	"	12:55 P Apr. 26	320	18	8.93	93.6	5.2	9,300	8.4	260	209	6.8
	"	11:20 A May 3	350	16	9.93	99.8	4.6	2,300	8.3	250	200	5.8
	"	10:05 A May 13	265	16	9.50	95.4	2.8	4,300	8.4	260	244	6.1
	"	9:10 A May 26	380	17	8.07	82.9	5.4	-	8.1	6,000	152	3.8
	"	8:50 A June 10	300	22	7.78	88.1	5.7	4,300	8.3	1,200	203	8.4
	"	9:40 A June 18	1,300	20	6.70	73.1	4.4	>110,000	8.1	13,000	156	5.1
	"	10:30 A June 28	9,000	19	5.91	63.2	4.6	750,000	7.7	16,000	126	1.0
	"	10:25 A July 13	450	25	7.22	86.2	3.1	43,000	8.3	6,500	180	5.1
	"	11:30 A July 27	400	25	5.90	70.4	5.3	150,000	7.6	10,600	112	1.2
	"	11:15 A Aug. 3	150	20	7.62	83.1	4.3	23,000	8.3	900	201	5.1
	"	6:20 A Sept. 7	120	16	7.63	76.5	6.7	9,300	8.5	800	200	4.1
	"	9:20 A Sept.22	55	19	8.71	93.2	5.8	9,300	8.6	500	209	6.4
	"	9:00 A Sept.27	65	11	10.48	94.7	5.1	9,300	8.6	350	244	5.8
	"	12:10 P Oct. 11	75	10	11.01	97.2	5.69	2,300	8.4	390	246	7.6
	"	7:25 A Oct. 29	220	11	9.33	84.2	4.53	24,000	8.3	600	224	6.0
	"	8:30 A Dec. 6	400	0	12.95	88.5	3.53	43,000	8.2	1,300	216	5.1
	"	7:15 A Dec. 22	370	0	7.32	50.0	0.44	24,000	8.3	340	248	6.5
Republican River	R - 299.5	10:55 A June 18	1,200	23	7.28	83.9	4.3	240,000	8.2	13,000	159	3.8
1 mile east of Holbrook (no bridge)	"	10:50 A July 13	400	25	7.30	87.1	3.5	23,000	8.3	6,300	182	5.9
	"	11:50 A July 27	420	19	6.15	65.8	8.4	150,000	7.7	5,500	117	3.2
Republican River	R - 300.5	1:00 P Sept.28	70	19	9.29	99.3	3.4	4,300	8.4	300	236	5.0
Bridge south of Holbrook	"	11:50 A Oct. 11	85	10	11.16	98.5	4.8	930	8.4	340	242	7.3
Republican River	R - 306.5	11:30 A Apr. 1	500	7	12.16	91.8	4.2	24,000	8.2	500	238	4.4
About 1 mile east of Cambridge (no bridge)	"	9:00 A Apr. 7	393	11	10.39	93.8	6.6	7,300	8.4	350	222	5.5
	"	8:40 A Apr. 19	326	18	9.16	96.2	4.1	15,000	8.5	250	223	4.8
	"	12:25 P Apr. 26	340	18	9.16	96.0	3.0	43,000	8.4	180	224	3.2
	"	10:50 A May 3	388	16	9.03	90.8	3.7	3,600	8.3	300	224	3.2
	"	9:30 A May 13	272	14	9.57	92.4	2.9	24,000	8.4	250	239	3.7

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 308.5	8:45 A May 26	364	16	8.96	90.2	4.2	-	8.3	1,100	214	3.8
About 1 mile east of Cambridge (no bridge)	"	11:20 A June 18	1,160	21	7.24	80.5	4.6	93,000	8.2	9,000	170	3.4
	"	11:05 A June 28	8,650	19	5.89	63.0	4.3	930,000	7.7	18,000	120	0.4
	"	11:10 A July 13	388	25	7.44	88.8	5.4	93,000	8.3	5,900	218	3.9
	"	12:05 P July 27	442	18	6.39	66.0	5.6	150,000	7.7	8,600	46	0.2
	"	12:00 N Aug. 3	126	20	5.52	60.2	10.6	-	7.7	8,000	117	0.5
	"	12:15 P Sept.28	68	14	9.72	93.8	6.5	110,000	8.3	400	238	3.9
	"	1:10 P Oct. 26	186	12	11.04	101.9	4.0	9,300	8.3	380	[illegible]	8.8
	"	1:10 P Dec. 7	373	2	12.84	92.8	3.8	24,000	8.4	260	253	4.3
	"	11:50 A Dec. 17	280	3	12.22	90.8	2.1	46,000	8.1	290	231	5.3
	"											
Medicine Creek	R - 309.6 M.C.-0.8	9:50 A June 10	46	23	8.59	99.0	7.2	46,000	8.4	500	206	3.9
Bridge - U.S. Highway No. 6 and No. 34	"	11:35 A June 18	65	21	7.62	84.8	6.4	240,000	8.2	1,000	235	3.9
	"	11:25 A June 28	1,300	19	5.97	63.9	5.4	930,000	7.7	20,500	105	0.7
	"	11:25 A July 13	57	25	8.00	95.5	6.5	460,000	8.3	1,100	233	3.2
	"	12:25 P July 27	70	19	6.19	66.2	5.8	93,000	7.9	6,400	112	0.5
	"	12:10 P Aug. 3	120	20	5.25	57.3	4.8	240,000	7.6	6,700	128	0.6
	"	10:00 A Aug. 16	60	22	7.09	80.2	5.4	>110,000	7.9	9,200	185	3.1
	"	11:40 A Sept.28	42	14	9.58	92.5	5.0	240,000	8.2	380	237	4.4
	"	11:30 A Oct. 11	40	7	11.29	92.9	5.1	110,000	8.2	300	248	4.0
	"	12:55 P Dec. 7	55	4	12.96	98.6	4.9	24,000	8.4	300	257	4.9
	"	11:54 A Dec. 17	55	4	12.67	96.4	3.4	>110,000	8.1	140	245	5.1
Medicine Creek	R - 309.6 M.C.-3.0	8:30 A Apr. 7	57	11	10.10	91.3	7.0	91	8.4	310	199	5.5
County bridge at Cambridge	"	11:55 A Apr. 26	58	16	9.30	93.5	2.2	430	8.4	200	222	3.2
	"	10:20 A May 3	69	16	9.63	96.8	4.4	1,500	8.3	200	198	7.1
	"	9:05 A May 13	51	14	9.50	91.7	2.2	2,400	8.3	260	237	2.2
	"	8:15 A May 26	42	15	9.33	91.8	3.2	-	8.3	240	218	2.1
	"	10:00 A June 10	46	23	9.49	109.3	7.0	930	8.4	500	213	3.8
	"	12:05 P June 18	64	22	7.61	86.2	3.6	24,000	8.2	900	227	3.8
	"	10:15 A Aug. 16	56	22	6.98	79.1	5.2	110,000	7.9	8,500	185	2.5
	"	11:30 A Sept.28	42	13	9.83	96.7	3.0	910	8.3	400	234	3.8
	"	11:15 A Oct. 11	40	7	11.33	93.4	2.7	2,400	8.3	310	240	4.0
Medicine Creek	R - 309.6 M.C.-9.5	11:15 A Apr. 1	-	8	11.59	97.8	3.4	930	8.2	320	236	3.8
Bridge at Medicine Creek Dam Site	"	8:00 A Apr. 19	-	15	9.00	88.7	2.6	430	8.5	190	196	3.7
	"	10:30 A June 10	35	24	9.52	111.6	5.5	4,300	8.4	350	224	3.5
	"	12:45 P June 18	50	24	8.08	94.8	3.7	9,300	8.3	650	228	3.8
	"	12:00 N July 13	45	27	13.49	167.2	10.9	360	8.2	650	195	2.9
	"	1:10 P July 27	50	22	7.04	79.7	5.6	1,500	8.0	400	166	2.3
	"	12:50 P Aug. 3	100	20	7.65	83.4	4.0	24,000	8.2	330	192	1.7
	"	9:40 A Aug. 16	40	22	7.50	84.9	2.8	15,000	8.4	700	204	2.8
	"	11:05 A Sept.28	35	12	10.17	93.8	3.4	4,300	8.3	380	232	3.3
	"	10:55 A Oct. 11	34	7	11.70	96.2	3.1	2,400	8.2	290	238	4.1

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Medicine Creek	R - 309.6 M.C. - 35.0	12:40 P June 11	50	25	8.97	107.0	4.5	15,000	8.6	180	216	2.3
2½ miles east of Curtis, Nebraska -	"	6:00 A July 6	35	19	7.27	77.8	3.4	15,000	8.4	270	222	1.9
no bridge	"	7:40 A July 19	50	20	7.41	80.8	3.0	24,000	8.1	380	210	1.8
	"	7:20 A July 26	19	18	8.40	88.1	4.3	24,000	8.4	200	216	2.2
	"	7:40 A Aug. 2	40	18	7.37	77.3	2.8	46,000	8.3	290	215	1.8
	"	9:50 A Sept. 3	22	20	8.25	90.0	3.5	46,000	8.4	240	231	2.4
	"	9:00 A Oct. 11	20	4	11.00	83.8	3.2	4,600	8.1	130	242	3.1
Medicine Creek	R - 309.6 M.C. - 36.5	12:55 P June 11	50	25	8.87	105.8	4.5	46,000	8.4	180	216	1.6
1 mile east of Curtis, No bridge	"	7:20 A June 21	500	14	8.16	78.7	4.7	9,300	8.2	550	221	1.1
	"	7:50 A June 29	40	18	7.33	76.8	3.9	93,000	8.2	1,100	214	0.9
	"	6:15 A July 6	35	19	7.23	77.3	4.1	28,000	8.0	500	182	0.6
	"	7:25 A July 19	50	20	7.21	78.6	3.3	43,000	8.2	500	213	0.6
	"	7:40 A July 26	18	16	8.47	88.8	4.9	43,000	8.2	250	181	1.7
	"	7:55 A Aug. 2	40	18	7.32	76.7	3.3	93,000	8.4	300	219	1.8
	"	10:10 A Sept.3	21	21	7.94	88.3	5.9	110,000	8.3	280	230	2.8
	"	9:20 A Oct. 11	18	5	10.78	84.1	4.2	110,000	8.2	180	241	3.4
Medicine Creek	R - 309.6 M.C. - 37.7	12:20 P June 11	50	25	8.57	102.3	3.6	9,300	8.2	250	218	1.6
Bridge on State Highway S-23, South	"	6:50 A June 21	500	14	7.94	76.6	4.5	9,300	8.2	600	222	1.1
of Curtis	"	8:15 A June 29	36.9	18	7.26	76.1	3.6	43,000	8.2	1,100	212	0.6
	"	6:30 A July 6	35	20	7.36	80.3	3.6	9,300	8.3	500	217	0.8
	"	11:25 A July 14	490	18	4.47	46.9	8.8	>110,000	7.9	29,000	83	1.5
	"	8:00 A July 19	50	20	7.38	80.5	3.2	9,300	8.3	450	216	-
	"	7:55 A July 26	18.2	19	8.26	88.3	4.4	<360	8.6	260	210	0.9
	"	8:10 A Aug. 2	40	18	7.71	80.8	3.3	2,400	8.5	300	216	1.1
	"	10:20 A Sept.3	20	23	8.08	93.1	2.9	2,300	8.3	330	230	3.0
	"	9:35 A Oct. 11	17	5	10.91	85.3	3.6	2,400	8.2	210	250	3.5
Republican River	R - 310.9	10:50 A Apr. 1	535	7	11.46	94.2	2.9	9,300	8.2	500	221	6.2
County Bridge, south of Cambridge	"	8:50 A Apr. 7	330	11	9.78	88.2	1.7	4,300	8.4	330	226	8.9
	"	8:20 A Apr. 19	270	18	8.72	91.4	4.7	360	8.5	250	234	7.6
	"	12:10 P Apr. 26	280	18	9.13	95.7	4.4	930	8.5	200	217	7.1
	"	10:35 A May 3	320	16	8.77	88.2	2.9	930	8.3	370	214	3.0
	"	9:15 A May 13	220	14	9.61	92.7	2.1	390	8.3	160	237	7.2
	"	8:25 A May 26	320	15	8.38	82.5	4.8	-	8.1	4,200	147	4.2
	"	9:40 A June 10	195	23	7.44	85.7	5.7	>11,000	8.4	2,500	208	7.1
	"	11:50 A June 18	1,100	21	7.17	79.8	4.5	43,000	8.1	11,500	147	3.2
	"	11:40 A June 28	3,350	20	6.74	73.5	5.7	240,000	7.7	14,000	124	1.3
	"	10:35 A July 13	330	26	7.19	87.5	2.9	93,000	8.3	5,200	180	5.9
	"	12:45 P July 27	370	22	7.67	86.9	6.4	3,600	8.2	250	186	9.2
	"	12:20 P Aug. 3	10	21	7.54	83.9	5.0	-	8.3	250	208	8.2
	"	12:00 N Sept.28	26	17	9.21	94.6	2.2	< 300	8.3	40	244	9.0
	"	11:00 P Oct. 26	130	12	9.97	91.8	4.6	4,600	8.4	800	230	15
	"	12:45 P Dec. 7	320	1	12.92	90.8	3.6	24,000	8.4	1,000	228	7.3
	"	11:36 A Dec. 17	220	2	13.01	94.0	1.7	24,000	8.3	340	234	7.8

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 319.2	10:20 A Apr. 1	520	7	11.13	91.6	2.8	12,000	8.2	450	228	6.1
County bridge 1 mile south of Bartley	"	10:50 A Apr. 5	350	11	9.84	88.8	1.9	43,000	8.4	310	229	5.7
	"	10:05 A Apr. 12	315	10	10.66	94.0	2.8	23,000	8.4	190	225	6.9
	"	11:30 A Apr. 26	275	17	9.12	93.7	5.0	4,300	8.5	180	226	8.1
	"	9:55 A May 3	330	15	9.49	93.5	4.5	9,300	8.3	240	211	8.4
	"	8:45 A May 13	225	12	9.94	91.7	2.1	1,500	8.2	170	240	7.1
	"	8:00 A May 26	300	14	7.86	75.9	5.6	-	8.2	5,500	155	4.4
	"	9:00 A June 11	175	21	7.57	84.2	3.2	46,000	8.6	1,500	214	8.9
	"	8:45 A June 21	2,100	16	7.57	76.1	5.4	460,000	8.1	11,000	130	3.7
	"	10:30 A June 29	1,900	19	7.19	76.9	4.7	120,000	7.9	11,500	130	3.0
	"	8:15 A July 6	275	22	7.82	88.6	4.2	9,100	8.3	900	194	7.7
	"	6:55 A July 14	310	20	7.20	78.5	3.3	43.000	8.6	2,400	210	7.5
	"	10:45 A July 19	330	23	7.10	81.8	4.7	460,000	8.3	3,500	156	4.0
	"	9:10 A July 26	150	22	8.68	98.3	8.0	9,100	8.5	310	192	8.0
	"	9:55 A Aug. 2	30	21	7.60	84.5	4.2	4,300	8.5	250	214	9.0
	"	9:25 A Aug. 16	[illegible]	22	7.79	88.2	4.2	110,000	8.6	1,000	186	6.6
	"	2:40 P Sept. 3	50	29	7.09	91.3	6.5	3,600	8.7	270	242	8.9
	"	10:40 A Sept. 28	30	14	9.50	91.7	2.3	2,400	8.3	45	240	8.1
	"	12:45 P Oct. 26	135	11	9.87	89.1	4.9	46,000	8.3	800	234	15
	"	12:15 P Dec. 7	325	4	12.83	97.7	4.0	7,500	8.4	650	216	7.9
	"	11:12 A Dec. 17	225	2	13.01	94.0	1.8	24,000	8.3	290	228	8.5
Republican River	R - 325.8	10:00 A Apr. 1	500	6	11.07	88.8	2.2	43,000	8.2	400	222	5.5
County bridge 1/2 mile south of Indianola	"	10:30 A Apr. 5	360	11	9.89	89.3	1.7	9,100	8.4	320	229	6.9
	"	9:45 A Apr. 12	320	10	10.52	92.9	2.8	4,300	8.4	200	224	7.9
	"	11:15 A Apr. 26	270	16	8.96	90.2	3.6	24,000	8.5	190	223	7.4
	"	9:20 A May 3	340	14	8.93	86.3	5.8	110,000	8.2	400	210	8.2
	"	8:15 A May 13	230	11	9.93	89.7	2.7	24,000	8.2	170	232	7.2
	"	7:40 A May 26	280	14	8.27	89.8	5.2	-	8.2	3,900	148	6.7
	"	9:20 A June 11	175	22	7.87	89.1	3.1	23,000	8.6	1,300	212	7.3
	"	9:15 A June 21	2,100	17	7.40	76.0	5.1	460,000	8.1	10,000	135	3.9
	"	10:50 A June 29	1,800	20	7.06	77.0	4.3	240,000	8.0	14,000	135	3.0
	"	8:35 A July 6	250	23	7.58	87.3	4.3	43,000	8.2	1,000	173	6.7
	"	7:15 A July 14	300	20	7.17	78.2	3.3	43,000	8.6	2,200	208	7.7
	"	11:05 A July 19	320	24	7.01	82.2	4.4	23,000	8.3	3,000	155	3.4
	"	9:30 A July 26	100	22	8.83	100.0	6.9	9,300	8.3	280	174	9.0
	"	10:15 A Aug. 2	35	22	7.71	87.3	3.6	15,000	8.5	390	230	8.0
	"	8:55 A Aug. 16	140	21	7.60	84.5	4.5	46,000	8.7	900	198	7.1
	"	2:10 P Sept.3	45	30	7.42	97.3	5.0	3,600	8.7	300	246	7.5
	"	10:15 A Sept.28	35	11	10.82	97.8	2.6	1,500	8.3	100	252	7.5
	"	12:20 P Oct. 26	140	12	10.00	92.3	4.3	24,000	8.3	650	234	7.0
	"	11:25 A Dec. 7	330	1	12.46	87.5	3.4	4,300	8.1	500	216	8.0
	"	10:50 A Dec. 17	230	1	12.95	90.9	2.2	4,600	8.3	300	231	8.1

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Red Willow Creek	R-329.6 R.W.C.-1.8	9:40 A April 1	37	6	10.88	87.3	3.4	300	8.2	350	259	4.6
Bridge - U.S.Highway No. 6 and No. 34	"	10:05 A Apr. 5	35	11	9.59	86.5	3.7	230	8.4	350	259	5.2
	"	9:30 A Apr. 12	33	11	10.35	93.5	2.3	>11,000	8.4	180	223	6.8
	"	10:50 A Apr. 26	32	13	9.54	90.0	5.1	930	8.2	350	263	6.0
	"	8:35 A May 3	32	15	8.74	86.1	3.5	4,300	8.2	400	250	5.3
	"	8:00 A May 13	29	12	8.89	82.1	2.8	4,300	8.3	210	260	4.7
	"	7:15 A May 26	20	14	8.65	83.4	4.8	-	8.3	350	223	4.7
	"	9:40 A June 11	20	23	7.61	87.7	4.0	9,300	8.5	450	254	4.9
	"	9:55 A June 21	23	15	8.22	81.0	4.1	24,000	8.4	700	137	6.3
	"	11:40 A June 29	65	19	6.61	70.7	5.3	93,000	7.7	8,500	135	2.4
	"	8:50 A July 6	33	23	7.72	88.9	4.9	3,600	8.3	650	232	3.9
	"	7:40 A July 14	38	20	6.30	68.7	3.6	9,300	8.3	1,200	246	4.3
	"	10:10 A July 19	48	23	6.49	74.8	4.4	75,000	7.8	3,900	144	1.0
	"	9:55 A July 26	37	22	7.70	87.2	3.8	2,300	8.5	350	252	4.0
	"	10:35 A Aug. 2	28	21	8.02	89.2	4.4	9,300	8.5	310	242	5.2
	"	8:35 A Aug. 16	17	21	6.50	72.3	4.2	>110,000	8.0	600	232	4.5
	"	1:55 P Sept. 3	14	23	7.08	81.5	3.5	24,000	8.1	20	223	5.3
	"	10:05 A Sept. 28	16	11	9.20	83.1	2.6	4,300	8.2	160	254	6.3
	"	12:00 N Oct. 26	23	9	10.45	90.3	3.4	2,300	8.3	360	254	5.1
	"	10:45 A Dec. 7	28	5	12.77	99.7	2.7	360	8.4	290	298	9.4
	"	10:00 A Dec. 17	28	3	12.71	94.5	3.9	430	8.3	240	286	6.8
Red Willow Creek	R-329.6 R.W.C.-17.7	11:40 A June 11	14	23	7.92	91.2	4.2	9,300	8.3	360	257	5.3
Bridge - U. S. Highway #83, 10 miles North of McCook	"	5:55 A June 21	15	14	8.16	78.7	4.5	46,000	8.3	550	231	5.9
	"	7:00 A June 29	57.4	16	7.17	72.1	5.6	93,000	8.0	3,600	184	4.8
	"	4:50 A July 6	20	21	6.13	68.2	4.7	3,600	8.2	700	203	3.9
	"	9:50 A July 14	15.6	21	7.00	77.9	3.4	9,300	8.3	1,100	239	4.1
	"	6:25 A July 19	30	20	6.59	71.9	3.8	43,000	8.1	1,200	206	3.4
	"	6:15 A July 26	16.8	20	6.95	75.8	4.6	4,300	8.6	310	240	4.5
	"	6:35 A Aug. 2	20	19	6.50	69.5	4.2	4,300	8.7	270	238	4.3
	"	11:20 A Sept. 3	8	23	7.87	90.7	4.1	15,000	8.0	380	226	6.2
	"	8:25 A Sept. 28	10	9	9.34	80.6	2.9	4,300	8.1	150	243	6.6
	"	7:50 A Oct. 11	13	4	10.21	77.8	5.7	2,400	7.9	400	266	7.8
	"	10:05 A Oct. 26	15	6	10.66	85.5	3.8	1,500	8.3	400	257	6.1
Republican River	R 330.3	9:20 A Apr. 1	440	6	11.28	90.4	2.5	46,000	8.2	450	225	5.0
Bridge 4 miles west of Indianola	"	10:15 A Apr. 5	330	11	9.87	89.1	1.9	24,000	8.4	300	225	6.4
	"	9:15 A Apr. 12	290	9	10.44	90.3	5.1	360	8.4	240	260	5.7
	"	9:00 A May 3	320	14	8.54	82.5	5.5	110,000	8.2	370	201	8.4
	"	7:50 A May 13	210	11	9.62	86.7	2.4	93,000	8.3	160	228	7.7
	"	7:25 A May 26	250	14	8.12	78.4	4.8	-	8.2	3,600	152	4.4
	"	8:30 A June 11	155	21	7.64	85.0	3.4	150,000	8.6	1,200	207	7.9
	"	9:40 A June 21	2,100	16	7.79	78.3	5.4	430,000	8.1	9,000	132	4.0
	"	12:00 N June 29	1,700	22	7.10	80.4	4.5	93,000	8.1	15,000	140	3.4
	"	9:05 A July 6	200	23	7.54	86.9	4.3	23,000	8.2	1,100	170	7.4
	"	7:30 A July 14	250	21	7.16	79.6	4.2	43,000	8.6	2,000	206	7.9

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R-330.3	9:50 A July 19	270	23	7.08	81.6	4.1	93,000	8.3	2,500	165	5.5
Bridge 4 miles west of Indianola	"	10:15 A July 26	60	23	8.65	99.7	6.9	75,000	8.5	210	195	11
	"	10:45 A Aug. 2	10	23	6.90	79.5	4.8	3,600	8.4	25	256	15
	"	8:20 A Aug. 16	160	21	7.80	86.8	5.6	46,000	8.8	700	206	9.0
	"	1:45 P Sept. 3	30	29	6.63	85.3	1.3	360	8.6	650	265	16
	"	11:45 A Oct. 26	120	10	10.20	89.9	5.0	24,000	8.3	450	223	7.9
	"	11:00 A Dec. 7	300	3	12.84	95.4	2.5	9,300	8.4	550	215	6.1
	"	10:16 A Dec. 17	200	1	13.00	91.3	1.7	4,300	8.3	260	226	7.0
Republican River	R-334.5	9:55 A June 11	150	23	7.82	90.1	3.1	93,000	8.6	1,100	211	7.6
3½ miles east of McCook - No bridge	"	10:10 A June 21	2,100	17	7.74	79.5	5.3	460,000	8.1	9,000	130	3.8
	"	9:55 A June 29	1,650	19	7.35	78.6	4.8	150,000	8.0	14,000	132	3.3
	"	9:20 A July 6	190	24	7.60	89.1	4.2	9,100	8.2	1,000	168	7.1
	"	7:55 A July 14	240	21	7.11	79.1	3.8	24,000	8.7	1,300	196	7.8
	"	11:25 A July 19	270	24	7.00	82.1	3.7	93,000	8.3	1,700	180	5.2
	"	10:30 A July 26	60	24	8.35	97.9	6.1	93,000	8.3	220	180	10
	"	11:00 A Aug. 2	10	24	7.89	92.5	3.7	93,000	8.5	25	253	17
	"	8:00 A Aug. 16	160	20	7.55	82.3	5.4	46,000	8.7	650	206	8.5
	"	1:00 P Sept. 3	30	30	10.92	143.5	7.4	23,000	8.7	25	254	28
	"	11:30 A Oct. 26	120	10	10.33	91.0	4.8	240,000	8.4	450	228	7.1
	"	10:20 A Dec. 7	305	3	12.42	92.3	1.6	4,300	8.2	500	204	4.9
	"	9:25 A Dec. 17	205	0	13.12	89.7	1.2	7,500	8.3	250	222	7.1
Republican River	R-336.0	10:35 A June 11	150	25	7.46	89.0	3.1	43,000	8.3	1,500	194	6.6
3½ miles east and 1/2 mile south	"	12:35 P June 29	1,600	22	7.14	80.9	4.6	750,000	8.1	14,000	139	4.0
McCook - No bridge	"	10:15 A July 6	185	24	7.69	90.2	4.6	9,100	8.2	1,000	181	7.8
	"	8:15 A July 14	230	22	7.24	82.0	4.6	43,000	8.6	1,400	204	10
	"	11:50 A July 19	270	24	7.12	83.5	3.6	240,000	8.3	1,400	180	8.6
	"	11:00 A July 26	55	26	8.10	98.5	6.8	43,000	8.2	200	174	11
	"	11:30 A Aug. 2	15	25	8.06	96.2	4.1	460,000	8.5	25	244	17
	"	7:40 A Aug. 16	200	20	6.95	75.7	5.6	110,000	8.7	600	188	9.5
	"	1:20 P Sept. 3	29	31	11.39	151.8	8.4	24,000	8.6	40	256	25
	"	11:15 A Oct. 26	125	10	10.38	91.4	4.1	43,000	8.3	400	226	9.6
	"	10:00 A Dec. 7	310	3	12.75	94.7	2.9	7,500	8.3	450	206	5.2
	"	9:30 A Dec. 17	210	0	12.39	84.6	1.3	46,000	8.3	140	208	7.1
Republican River												
1½ mile east of McCook no bridge	R - 337.7	9:00 A Apr. 1	420	6	11.25	90.2	2.1	43,000	8.2	410	223	8.0
	"	9:50 A Apr. 5	340	11	9.88	89.2	1.8	39,000	8.4	300	224	5.6
	"	9:00 A Apr. 12	300	9	10.50	90.8	2.4	15,000	8.4	185	228	8.7
	"	10:30 A Apr. 26	235	14	9.33	90.1	5.5	7,300	8.4	160	219	7.7
	"	8:15 A May 3	340	13	8.07	76.2	5.6	23,000	8.2	440	196	8.9
	"	7:35 A May 13	220	11	9.74	88.0	2.3	43,000	8.2	170	217	7.1
	"	6:50 A May 26	220	14	6.12	78.3	4.6	-	8.2	3,500	161	4.8
	"	10:55 A June 11	150	25	7.68	91.6	3.8	24,000	8.7	900	213	7.5

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River 1½ mile east of McCook - no bridge	R-337.7	12:50 P June 29	1,550	22	7.18	81.3	4.3	240,000	8.1	11,500	140	3.1
	"	10:00 A July 6	180	24	7.83	91.8	4.1	23,000	8.3	1,100	178	6.8
	"	8:55 A July 14	225	22	7.34	83.1	4.0	9,300	8.7	1,400	200	7.2
	"	12:15 P July 19	265	25	6.99	83.4	3.4	93,000	8.4	1,300	187	4.8
	"	12:00 N. July 26	55	27	7.60	94.2	5.1	<3,600	8.5	380	208	9.2
	"	12:00 N Aug. 2	20	27	1.64	20.3	>30.1	>1,100,000	8.1	35	315	27
	"	7:15 A Aug. 16	220	19	7.77	83.1	4.7	9,300	8.7	600	228	8.2
	"	12:25 P Sept. 3	28	28	4.23	53.5	>10	>1,100,000	7.9	85	318	36
	"	10:45 A Oct. 26	130	8	10.38	87.5	3.3	9,100	8.3	410	227	7.2
	"	9:30 A Dec. 7	315	0	12.74	87.1	2.5	7,300	8.3	388	213	5.8
	"	9:00 A Dec. 17	215	0	12.99	86.8	2.4	4,300	8.3	250	225	7.3
Republican River Bridge at McCook U.S.Highway No. 83	R - 339.3	8:45 A Apr. 1	410	4	11.29	85.9	1.9	2,300	8.2	390	219	6.8
	"	9:20 A Apr. 5	345	11	10.03	90.7	1.4	930	8.4	280	224	5.6
	"	8:45 A Apr. 12	300	9	10.42	90.2	1.9	>11,000	8.4	180	215	6.3
	"	10:15 A Apr. 26	235	14	9.64	93.1	2.6	910	8.4	150	221	7.1
	"	8:00 A May 3	360	13	8.98	84.8	3.6	9,300	8.2	450	191	6.3
	"	7:15 A May 13	225	10	9.89	87.3	1.8	2,300	8.3	170	216	7.8
	"	6:30 A May 26	200	13	8.35	78.8	3.8	-	8.3	3,500	159	5.2
	"	10:05 A June 11	145	23	7.64	88.0	2.8	46,000	8.7	900	213	7.1
	"	1:30 P June 21	2,200	15	7.91	77.9	5.2	240,000	8.1	9,000	124	3.5
	"	1:00 P June 29	1,520	22	7.43	84.1	4.6	150,000	8.1	12,000	140	3.4
	"	9:45 A July 6	175	24	7.86	92.1	4.1	9,100	8.3	1,100	193	6.5
	"	9:30 A July 14	218	22	7.27	82.3	3.6	2,300	8.7	1,300	200	7.4
	"	12:30 P July 19	265	25	7.10	84.7	3.4	23,000	8.4	1,300	187	5.5
	"	11:30 A July 26	53.8	26	7.20	87.6	5.7	24,000	8.4	310	202	10
	"	12:15 P Aug. 2	20	27	6.89	85.4	3.1	2,100	8.4	50	234	14
	"	7:00 A Aug. 16	250	19	7.60	81.4	4.3	24,000	8.7	650	209	7.8
	"	12:45 A Sept. 3	27	30	7.10	93.1	4.8	3,600	8.5	500	207	14
	"	11:00 A Oct. 26	130	8	10.61	89.5	2.4	7,500	8.3	400	226	6.3
	"	9:39 A Dec. 7	320	1	12.98	91.1	3.3	4,300	8.3	450	221	6.9
	"	9:20 A Dec. 17	220	0	12.20	83.4	1.3	2,400	8.3	200	207	6.6
Republican River County Bridge 1 mile southwest of McCook	R - 341.0	8:20 A Apr. 1	400	4	11.33	86.3	2.0	4,300	8.2	390	220	6.9
	"	9:20 A Apr. 5	350	11	10.06	90.9	1.1	360	8.4	280	228	4.8
	"	8:30 A Apr. 12	300	9	10.51	90.8	1.8	4,600	8.4	160	222	8.1
	"	9:50 A Apr. 26	235	13	9.82	92.7	2.6	2,400	8.4	120	216	7.6
	"	7:35 A May 3	380	13	9.10	85.9	3.9	9,300	8.2	450	190	7.2
	"	11:05 A June 11	145	25	7.50	89.5	3.4	9,300	8.5	1,000	212	7.8
	"	2:10 P June 21	2,200	14	7.70	74.3	5.0	110,000	8.0	8,500	110	2.6
	"	1:20 P June 29	1,500	22	7.16	81.1	4.6	43,000	8.0	13,000	138	2.7
	"	10:40 A July 6	170	25	7.56	90.2	4.0	43,000	8.3	1,000	188	6.2
	"	8:40 A July 14	215	22	7.39	83.7	3.9	15,000	8.7	1,300	198	7.5
	"	9:10 A Dec. 7	330	0	13.14	89.8	1.9	4,300	8.3	400	216	7.1
	"	8:35 A Dec. 17	230	0	12.70	86.8	1.2	2,400	8.3	200	218	6.7

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 349.5	7:35 A June 9	250	19	7.53	80.5	4.0	24,000	8.4	4,000	231	7.3
3 miles east of Culbertson - no	"	5:30 A June 23	975	16	7.72	77.6	3.6	46,000	8.3	2,600	152	4.5
bridge	"	5:15 A July 1	570	18	7.14	74.8	2.8	24,000	8.3	2,700	177	4.7
	"	8:20 A July 8	215	20	7.89	86.0	3.4	9,300	8.5	650	200	6.7
	"	6:30 A July 16	400	20	6.45	70.3	4.6	93,000	7.9	4,700	108	-
	"	9:00 A July 23	150	19	8.32	89.0	3.2	9,300	8.3	550	208	8.2
	"	8:45 A July 28	70	20	7.19	78.4	2.0	24,000	8.3	160	237	11
	"	7:45 A Sept. 3	24	18	9.18	96.2	2.8	9,300	7.9	200	239	16
	"	8:30 A Dec. 7	340	0	12.71	86.9	1.3	4,300	8.3	300	216	4.8
	"	8:01 A Dec. 17	240	0	12.60	86.2	5.0	4,600	8.1	180	210	6.0
Blackwood Creek	R - 350.2 Bl.C.-5.2	11:35 A Apr. 1	0.2	5	11.20	87.7	1.4	36	8.2	25	330	18
3 miles north of Culbertson	"	8:50 A Apr. 5	0.2	10	12.83	113.3	2.5	230	8.4	30	291	17
	"	8:05 A Apr. 12	0.4	10	13.55	119.6	2.5	36	8.4	20	262	17
	"	9:25 A Apr. 26	13	13	9.02	85.2	4.2	39	7.8	15	273	17
	"	7:00 A May 3	0.2	14	5.12	49.4	4.2	460	7.6	35	284	14
	"	6:05 A May 13	0.4	9	5.21	44.9	3.4	2,400	8.0	45	236	4.6
	"	6:00 A May 26	4.1	14	1.78	17.2	3.2	-	7.5	55	236	3.5
	"	6:50 A June 9	10	19	1.69	18.1	5.3	4,300	8.2	25	370	4.3
	"	5:35 A June 15	6.2	17	3.09	31.7	3.2	1,500	7.7	130	300	10
	"	5:45 A June 23	22	15	6.41	63.2	4.7	110,000	7.8	3,200	100	4.4
	"	5:30 A July 1	18	18	4.08	42.8	2.1	4,300	7.5	900	136	2.1
	"	8:00 A July 8	2.1	19	3.47	37.1	2.4	9,300	8.1	280	355	5.9
	"	7:00 A July 16	23	20	6.13	66.8	4.5	93,000	7.7	4,300	88	1.5
	"	8:45 A July 23	0.9	19	3.98	42.6	2.7	24,000	8.1	170	255	10
	"	8:30 A July 28	1.5	20	5.11	55.7	8.9	24,000	8.3	240	197	3.1
	"	8:55 A Aug. 6	1.9	16	5.09	51.2	3.6	7,500	8.1	250	213	4.6
	"	7:20 A Sept. 3	2.1	19	4.96	53.1	3.4	7,500	7.6	280	229	6.0
	"	9:25 A Oct. 26	0.8	7	4.04	33.2	4.8	360	7.8	20	358	16
Republican River	R - 350.8	3:45 P June 4	270	32	7.04	95.2	4.0	2,400	8.4	600	211	11
1 mile east of Culbertson - no	"	8:20 A June 9	240	21	7.56	84.1	2.8	46,000	8.4	550	181	4.5
bridge	"	6:45 A June 23	950	15	7.92	78.0	3.5	43,000	8.3	3,800	150	4.0
	"	6:00 A July 1	550	18	7.57	79.4	2.2	43,000	8.3	5,600	165	4.3
	"	7:35 A July 8	210	18	7.90	82.8	3.4	7,300	8.4	1,200	185	7.2
	"	7:15 A July 16	370	18	7.85	82.3	4.3	15,000	8.3	1,200	184	7.1
	"	8:25 A July 23	150	19	8.58	91.8	3.3	9,300	8.5	600	205	7.3
	"	8:05 A July 28	75	19	7.31	78.2	1.6	9,300	8.3	160	220	10
	"	8:25 A Aug. 6	55	15	7.98	78.6	2.1	46,000	8.4	310	198	8.8
	"	7:00 A Sept. 3	22	16	7.87	79.1	1.6	24,000	8.3	100	256	11
	"	8:55 A Oct. 26	155	6	11.21	89.9	4.2	1,500	8.4	400	231	6.9
	"	8:15 A Dec. 7	345	0	-	-	2.0	24,000	8.4	210	219	5.1
	"	7:55 A Dec. 17	240	1	12.83	90.2	3.9	46,000	8.1	180	204	5.3
Frenchman River (Creek)	R - 351.6											
Bridge - U. S. Highway No. 34. 2 miles	F.R.-4.4	7:00 A Apr. 1	178	6	10.48	84.1	2.2	1,500	8.2	280	204	4.0
west of Culbertson	"	8:20 A April 5	178	10	9.50	83.8	1.0	4,300	8.4	190	211	5.0

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Frenchman River(Creek) Bridge - U.S. Highway No. 34, 2 miles west of Culbertson	R - 351.6 F.R.-4.4	7:35 A Apr. 12	159	10	10.00	88.2	2.3	4,300	8.4	160	206	3.9
	"	8:50 A Apr. 26	97	12	9.56	88.2	3.0	4,300	8.3	120	220	7.0
	"	6:30 A May 3	73	14	9.21	88.8	2.6	9,300	8.2	85	218	5.5
	"	6:35 A May 13	68	9	9.89	85.4	2.0	2,300	8.2	75	228	4.9
	"	5:30 A May 26	43	12	9.12	84.2	1.2	-	8.3	45	240	5.4
	"	4:15 P June 4	104	28	6.71	84.7	3.2	4,300	8.4	330	218	5.1
	"	8:45 A June 9	80	21	10.62	118.1	5.4	9,300	8.4	220	229	5.6
	"	6:45 A June 15	70	17	7.93	81.4	2.2	7,500	8.1	180	236	4.3
	"	7:10 A June 23	151	15	7.82	77.0	3.0	43,000	8.3	1,600	188	3.0
	"	6:35 A July 1	150	19	7.38	78.9	2.7	24,000	8.3	1,400	195	2.5
	"	7:05 A July 8	99	18	8.15	85.4	3.6	9,300	8.6	800	202	3.6
	"	7:50 A July 16	138	19	6.83	73.0	4.8	240,000	7.9	5,100	120	-
	"	10:15 A July 23	43	20	8.22	89.6	2.9	<3,600	8.3	180	235	5.7
	"	7:40 A July 28	27	18	7.44	78.0	0.4	15,000	8.3	50	254	7.0
	"	7:55 A Aug. 6	24	15	8.11	79.9	0.8	4,300	8.3	170	242	7.1
	"	6:30 A Sept. 3	19	16	8.24	82.7	1.0	15,000	8.4	70	272	5.0
	"	8:30 A Oct. 26	92	6	10.55	84.6	2.2	4,300	8.3	130	220	5.2
	"	6:48 A Dec. 7	193	0	12.66	86.5	2.3	4,300	8.4	230	214	4.3
	"	7:15 A Dec. 17	176	0	12.51	85.5	1.8	9,300	8.1	100	202	4.8
	"	12:36 P Dec. 20	180	3	12.27	91.0	1.0	2,300	8.1	210	197	4.9
Frenchman River(Creek) County bridge 1 mile east of Palisade	R - 351.6 F.R.-21.5	11:10 A June 9	85	22	7.07	80.1	3.5	>110,000	8.4	370	200	5.2
	"	11:50 A June 15	50	19	7.67	82.0	3.6	43,000	8.2	280	210	3.5
	"	9:00 A June 23	100	16	7.43	74.7	6.1	240,000	8.3	2,500	193	3.1
	"	8:45 A July 1	100	20	7.32	79.8	2.6	43,000	8.3	700	194	2.4
	"	8:55 A July 8	60	20	7.62	83.1	3.2	23,000	8.3	1,100	183	2.6
	"	9:45 A July 16	75	20	7.13	77.8	4.0	75,000	8.0	2.100	160	0.6
	"	10:50 A July 23	20	20	7.91	86.3	4.1	23,000	8.2	220	197	2.6
	"	10:00 A July 28	15	20	7.34	80.0	0.9	15,000	8.2	25	230	5.4
	"	9:35 A Aug. 6	100	14	8.02	77.4	0.9	110,000	8.3	180	230	5.1
	"	12:00 N Dec. 20	160	1	12.33	86.6	1.4	2,300	8.1	100	196	4.4
Stinking Water Creek County bridge - 3 miles northwest of Palisade	R - 351.6 FR - 23.5 St.W.C.-3.0	11:35 A June 9	25	23	6.89	79.4	4.9	4,300	8.4	1,000	207	3.0
	"	11:30 A June 15	20	19	7.57	81.0	4.3	9,300	8.2	400	208	3.2
	"	9:30 A June 23	40	17	7.44	76.4	4.6	110,000	8.4	1,300	214	3.9
	"	9:00 A July 1	43.2	19	6.90	73.8	3.4	15,000	8.2	800	232	2.5
	"	9:10 A July 8	20	21	7.67	85.3	5.6	4,300	8.5	1,000	201	2.7
	"	10:00 A July 16	20	19	6.64	71.0	4.9	93,000	7.8	3,000	151	1.9
	"	11:05 A July 23	20	20	8.21	89.5	5.1	15,000	8.3	350	174	2.5
	"	10:20 A July 28	15	22	7.27	82.3	4.3	4,300	8.4	290	201	2.9
	"	9:50 A Aug. 6	15	16	7.99	80.3	3.6	46,000	8.5	300	200	3.4
	"	11:32 A Dec. 20	25	1	12.33	86.6	1.6	230	8.0	180	223	5.3
Frenchman River(Creek) County bridge 3 miles east of Wauneta	R - 351.6 F.R. - 38.0	12:00 N June 9	85	23	7.24	83.4	1.8	2,400	8.4	210	188	3.3
	"	11:05 A June 15	86	19	7.82	83.6	2.9	4,300	8.2	190	194	2.5

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Frenchman River (Creek)	R - 351.6 F.R.-38.0	10:00 A June 23	115	17	8.07	82.9	2.2	9,300	8.4	190	180	2.5
County bridge 3 miles east of Wauneta	″	9:25 A July 1	105	20	7.30	79.6	2.4	24,000	8.3	500	187	1.0
	″	9:40 A July 8	90	20	7.61	83.0	2.2	4,300	8.3	1,000	178	2.5
	″	10:30 A July 16	106	21	7.53	83.8	1.9	46,000	8.3	280	170	2.5
	″	12:00 N July 23	93	21	7.89	87.8	3.3	24,000	8.2	230	180	2.1
	″	10:45 A July 28	82	22	6.90	78.1	2.0	9,300	8.4	140	180	2.5
	″	10:30 A Aug. 6	86	16	8.07	81.1	1.6	24,000	8.3	210	187	2.0
	″	10:55 A Dec. 20	110	2	12.07	87.1	1.8	1,500	8.1	55	181	3.8
Frenchman River (Creek)	R - 351.6 F.R. -40.5	10:10 P June 9	85	23	7.00	80.6	4.8	110,000	8.4	190	188	2.7
U. S. Highway #6, 1 mile east of	″	10:50 A June 15	83	19	7.78	83.2	2.6	23,000	8.2	160	195	2.9
Wauneta	″	10:15 A June 23	110	17	8.02	82.2	2.2	9,300	8.4	220	182	2.7
	″	9:40 A July 1	105	20	7.30	79.6	2.9	4,300	8.3	290	185	1.9
	″	9:50 A July 8	90	20	7.52	82.0	2.7	21,000	8.2	1,100	178	1.9
	″	10:40 A July 16	105	21	7.36	81.9	2.0	93,000	8.3	220	175	2.1
	″	12:10 P July 23	90	21	7.81	86.9	3.6	39,000	8.2	190	180	1.8
	″	10:55 A July 28	80	22	6.71	76.0	2.2	240,000	8.2	160	178	2.0
	″	10:50 A Aug. 6	82	16	7.84	78.8	1.8	93,000	8.3	190	185	2.8
	″	10:45 A Dec. 20	110	2	12.05	87.0	1.8	24,000	8.1	50	183	4.1
Frenchman River (Creek)	R - 351.6 F.R. - 42.3	12:20 P June 9	85	23	7.37	84.9	2.0	15,000	8.4	190	187	2.2
Bridge - U.S. Highway #6, north of Wauneta	″	10:40 A June 15	80	19	7.97	85.2	1.6	910	8.2	180	186	2.6
	″	10:35 A June 23	100	17	8.16	83.8	1.9	9,300	8.4	170	176	2.3
	″	9:55 A July 1	105	19	7.70	82.4	2.5	910	8.3	280	180	1.1
	″	10:10 A July 8	90	20	7.67	83.6	2.1	1,500	8.2	800	176	1.7
	″	10:55 A July 16	100	21	7.66	85.4	1.9	9,300	8.3	250	175	2.0
	″	12:25 P July 23	90	21	7.73	86.0	-	2,300	8.3	170	174	1.8
	″	11:05 A July 28	75	23	6.99	80.5	1.9	4,300	8.3	190	172	1.9
	″	11:00 A Aug. 6	78	16	8.06	81.0	1.3	4,300	8.3	180	177	2.6
	″	10:30 A Dec. 20	110	2	11.97	86.4	1.2	<300	8.1	50	180	3.5
Frenchman River (Creek)	R - 351.6 F.R. - 50.0	12:55 P June 9	85	22	7.57	85.7	1.3	930	8.4	95	186	3.5
County bridge 2 mi. below Enders damsite	″	10:05 A June 15	75	18	7.94	83.2	2.0	4,600	8.2	130	190	2.3
	″	11:15 A June 23	96	17	8.53	87.6	2.3	2,400	8.4	140	180	2.3
	″	10:30 A July 1	106	20	7.73	84.3	2.2	2,400	8.3	220	187	1.6
	″	10:35 A July 8	91	20	8.08	88.1	2.4	2,400	8.3	600	173	2.0
	″	11:25 A July 16	98	21	7.72	85.9	1.9	9,300	8.3	210	176	2.3
	″	12:55 P July 23	86	21	8.11	90.2	3.2	930	8.1	260	181	1.7
	″	11:40 A July 28	70	23	7.18	82.7	1.9	4,300	8.3	90	179	1.9
	″	11:40 A Aug. 6	73	16	8.42	84.6	1.8	1,500	8.3	150	184	1.9
	″	10:00 A Dec. 20	109	2	12.15	87.7	1.3	36	8.0	300	183	3.6
Republican River	R -351.9	7:45 A Apr. 1	190	4	11.79	89.8	2.4	910	8.2	450	223	6.5
At Culbertson, Highway No. 17	″	8:[illegible] A Apr. 5	177	10	10.32	91.2	1.0	2,400	8.4	330	230	6.0
	″	7:50 A Apr. 12	136	9	10.80	93.2	1.2	2,400	8.4	170	220	6.4

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 351.9	9:10 A Apr. 26	115	12	9.88	91.1	1.8	93	8.4	95	216	7.3
At Culbertson, Highway No. 17	"	6:45 A May 3	343	13	8.92	83.3	4.3	>11,000	8.2	500	182	6.9
	"	6:20 A May 13	170	8	10.27	94.6	1.7	2,100	8.2	170	216	6.4
	"	5:45 A May 26	-	12	8.77	80.9	3.3	-	8.3	2,500	152	6.1
	"	4:00 P June 4	164	32	6.90	93.3	4.0	1,200	8.4	600	210	8.4
	"	7:05 A June 9	157	19	7.87	84.2	4.6	9,300	8.4	4,000	167	6.9
	"	6:20 A June 15	510	17	7.92	81.3	3.4	9,300	8.2	600	201	5.9
	"	6:15 A June 23	790	15	7.93	78.1	3.6	46,000	8.3	4,500	151	4.5
	"	6:15 A July 1	400	18	7.43	77.9	2.2	24,000	8.3	5,600	164	4.7
	"	7:20 A July 8	109	19	7.91	84.6	3.3	4,300	8.5	1,100	188	6.8
	"	7:25 A July 16	232	19	7.61	81.4	4.2	24,000	8.4	1,500	186	6.9
	"	8:10 A July 23	104	19	8.34	89.2	3.3	2,300	8.6	900	192	5.5
	"	7:55 A July 28	47	19	7.11	76.0	1.9	430	8.3	160	198	7.9
	"	8:10 A Aug. 6	31	15	8.03	79.1	1.9	15,000	8.4	340	182	7.8
	"	6:45 A Sept. 3	2.6	17	7.86	80.7	1.1	46,000	8.4	110	241	9.0
	"	9:10 A Oct. 26	62	6	11.02	69.1	2.8	360	8.4	450	244	7.7
	"	7:30 A Dec. 7	150	0	12.86	87.9	3.1	9,300	8.4	450	223	7.1
	"	7:30 A Dec. 17	65	0	12.86	87.9	3.6	4,600	8.2	220	226	7.8
Republican River	R - 360.5	9:25 A June 4	114	23	7.97	91.8	2.4	9,300	8.4	550	217	7.4
1½ mile east of Trenton - no bridge	"	9:20 A June 9	103	21	7.50	83.4	3.5	46,000	8.4	2,800	175	4.5
	"	7:45 A June 23	675	16	7.93	79.7	4.2	93,000	8.3	3,300	158	4.9
	"	7:10 A July 1	295	18	7.51	78.7	1.9	43,000	8.3	3,400	182	5.5
	"	6:30 A July 8	145	18	7.87	82.5	3.6	15,000	8.4	1,100	189	7.2
	"	8:15 A July 16	202	19	7.74	82.8	3.3	43,000	8.5	1,400	188	6.6
	"	7:25 A July 23	83	20	8.21	89.5	2.4	3,600	8.6	650	194	5.1
	"	6:55 A July 28	40	18	7.16	75.1	1.9	2,300	8.4	180	192	8.1
	"	7:20 A Aug. 6	19	15	8.09	79.7	2.1	24,000	8.3	340	176	6.5
	"	6:30 A Dec. 20	140	0	7.70	52.6	1.2	73	7.9	700	280	21
Republican River	R - 374.0	7:00 A June 4	100	19	7.96	85.1	1.2	4,300	8.4	390	217	8.5
1 mi. east of Stratton - no bridge	"	10:15 A June 9	90	24	6.73	78.9	2.4	24,000	8.4	1,700	183	4.9
	"	12:40 P June 15	13,000	12	7.07	65.3	>7.1	240,000	7.9	26,000	164	3.2
	"	8:15 A June 23	500	17	7.84	80.5	2.6	75,000	8.3	2,500	159	4.8
	"	7:50 A July 1	280	19	7.43	79.5	1.5	43,000	8.3	1,700	197	5.1
	"	5:55 A July 8	150	17	7.92	81.3	3.0	23,000	8.4	1,200	192	7.0
	"	8:50 A July 16	180	20	7.76	84.6	2.5	23,000	8.3	1,100	184	6.5
	"	6:55 A July 23	75	20	8.14	88.6	2.8	9,300	8.5	500	200	6.1
	"	6:25 A July 28	35	18	7.13	74.7	2.2	2,300	8.3	110	188	8.1
	"	6:50 A Aug. 6	25	15	8.05	79.3	1.4	24,000	8.4	320	204	7.9
	"	7:10 A Dec. 20	150	0	11.44	78.2	0.9	4,600	8.3	170	236	8.1
Republican River	R - 392.0	2:00 P June 3	140	27	6.22	77.1	0.7	1,500	8.4	320	172	4.2
2 mi. northeast of Benkelman - no bridge	"	10:05 A June 14	120	21	7.16	79.6	5.3	>110,000	8.1	1,200	148	4.6
	"	10:05 A June 22	920	18	7.63	80.0	5.0	93,000	8.1	6,400	139	3.9

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 392.0	11:35 A June 30	300	24	7.26	85.1	2.1	93,000	8.3	1,300	205	7.0
2 mi. northeast of Benkelman - no bridge	"	10:40 A July 9	625	22	7.23	81.9	3.3	43,000	8.4	1,300	167	7.4
	"	12:40 P July 15	168	25	6.60	78.8	3.9	9,100	8.1	55	170	20
	"	12:05 P July 21	145	26	6.86	83.5	2.7	93,000	8.5	900	181	4.7
	"	10:35 A July 29	46	26	6.57	79.9	3.2	460,000	8.4	130	201	6.9
	"	11:10 A Aug. 4	60	21	6.94	77.2	3.4	240,000	8.2	700	168	5.0
	"	8:10 A Dec. 20	160	0	11.93	81.6	0.5	910	8.2	65	230	7.4
Republican River	R - 393.5	1:45 P June 3	145	27	7.77	96.3	3.6	110,000	8.4	290	176	4.4
County bridge 1 mile east of Benkelman	"	9:40 A June 14	123	20	7.66	83.5	4.2	93,000	8.1	250	156	6.1
	"	9:40 A June 22	898	17	7.51	77.1	5.1	93,000	8.1	3,600	142	4.5
	"	11:10 A June 30	298	22	7.09	80.3	1.8	23,000	8.3	1,300	214	8.0
	"	11:10 A July 9	622	22	7.31	82.8	3.2	39,000	8.4	1,500	180	6.6
	"	1:00 P July 15	166	26	6.67	81.1	3.2	23,000	8.3	900	172	6.2
	"	12:40 P July 21	143	26	7.15	87.0	2.2	93,000	8.5	1,000	176	3.4
	"	10:50 A July 29	46	26	6.63	80.7	1.7	910	8.5	140	190	4.9
	"	11:25 A Aug. 4	60	21	7.18	79.9	2.4	23,000	8.3	500	174	4.8
	"	8:15 A Dec. 20	160	0	11.23	76.8	0.5	2,300	8.3	110	229	8.1
South Fork Republican	R - 393.6 SFR - 3.6	1:00 P June 3	48	23	7.23	83.3	1.8	930	8.4	400	174	7.1
Bridge 2½ miles south of Benkelman	"	9:05 A June 14	64	19	7.92	84.6	3.6	15,000	8.2	1,200	178	5.6
	"	9:15 A June 22	302	18	8.06	84.5	3.4	93,000	8.2	2,600	161	3.6
	"	9:35 A June 30	155	20	7.66	83.3	2.0	9,100	8.3	1,600	172	5.9
	"	11:25 A July 9	501	24	7.28	85.3	4.9	46,000	8.0	5,800	111	5.7
	"	1:20 P July 15	52	29	6.52	83.9	3.0	9,300	8.5	600	210	7.1
	"	11:20 A July 21	29	27	6.93	85.9	2.6	2,300	8.5	300	214	7.0
	"	10:10 A July 29	14	26	6.50	79.1	1.2	4,300	8.5	65	227	9.4
	"	10:50 A Aug. 4	14	21	7.20	80.1	1.0	4,300	8.5	210	219	10
	"	8:45 A Dec. 20	50	1	12.14	85.3	1.0	36	8.3	160	233	9.2
South Fork Republican	R - 393.6 SFR - 25.0	8:45 A June 8	52	19	7.81	83.5	1.5	4,300	8.4	800	199	8.6
2½ miles north and 1 mile east of St. Francis - no bridge	"	2:20 P June 17	60	27	5.88	72.9	3.5	110,000	8.3	3,200	164	2.4
	"	8:00 A June 24	60	15	8.59	84.6	0.8	9,300	8.2	290	212	5.6
	"	1:45 P July 2	60	27	6.78	84.0	1.2	3,900	8.3	550	240	5.4
	"	2:05 P July 7	42	30	6.56	86.0	2.8	24,000	8.5	150	219	5.9
	"	2:45 P Aug. 5	20	18	7.86	82.4	2.2	24,000	8.5	60	204	7.9
South Fork Republican	R - 393.6 SFR - 26.0	9:15 A June 8	52	19	7.64	81.7	1.2	4,300	8.4	800	199	6.5
2 miles north of St. Francis - no bridge	"	2:00 P June 17	60	27	5.81	72.0	3.9	15,000	8.3	3,100	165	1.6
	"	8:15 A June 24	60	15	8.36	82.4	1.0	4,300	8.2	290	220	5.8
	"	12:55 P July 2	60	26	6.86	83.5	1.4	4,300	8.3	1,000	236	5.9
	"	1:45 P July 7	40	30	6.40	83.9	2.6	110,000	8.3	150	219	6.7
	"	2:25 P Aug. 5	21	19	7.44	79.6	1.7	46,000	8.5	40	216	6.7

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
South Fork Republican	R - 393.6 SFR - 28.0	9:40 A June 8	21	19	7.58	81.1	1.2	9,300	8.4	700	196	6.6
Bridge at St. Francis	"	1:15 P June 17	60	26	6.36	77.4	4.5	46,000	8.2	3,600	162	2.1
	"	8:30 A June 24	60	16	8.30	83.4	0.9	9,300	8.3	320	220	5.2
	"	12:45 P July 2	55	27	6.48	80.3	0.8	4,300	8.3	550	227	5.5
	"	1:30 P July 7	38	30	6.50	85.2	2.7	24,000	8.5	140	216	6.0
	"	2:10 P Aug. 5	22	19	7.40	79.1	2.3	46,000	8.5	45	209	7.4
	"	1:30 P Dec. 15	65	2	12.07	87.2	1.8	91	8.1	400	195	5.9
South Fork Republican	R - 393.6 SFR - 36.0	10:10 A June 8	50	19	7.64	81.7	1.2	4,300	8.4	450	201	9.3
Bridge - 9 miles southwest of St.	"	12:30 P June 17	53	27	6.17	76.5	4.0	15,000	8.2	2,100	158	2.1
Francis (St. Francis Damsite)	"	8:55 A June 24	55	16	8.43	84.7	1.0	4,300	8.3	300	206	4.3
	"	12:20 P July 2	50	27	6.75	83.6	1.1	4,300	8.3	340	220	4.9
	"	1:00 P July 7	34	30	6.40	83.9	1.4	730	8.3	140	201	4.7
	"	12:40 P Aug. 5	20	21	7.20	80.1	0.8	1,500	8.4	50	195	4.6
	"	12:45 P Dec. 15	63	2	11.83	85.5	1.3	36	8.1	250	190	5.5
South Fork Republican	R - 393.6 SFR - 52.9	11:00 A June 8	40	19	7.56	80.9	1.1	2,400	8.4	280	187	5.4
Bridge - 2 miles below Bonny Damsite	"	11:40 A June 17	60	26	6.22	83.7	2.3	4,300	8.3	450	181	2.4
on U.S. Highway #53	"	9:35 A June 24	63	19	8.11	86.7	1.1	24,000	8.2	170	196	4.0
	"	11:15 A July 2	39	25	7.01	83.7	1.0	9,300	8.4	330	200	4.2
	"	12:25 P July 7	28	28	6.68	84.3	1.3	4,300	8.4	140	190	4.2
	"	12:00 N Aug. 5	16	20	7.10	77.4	1.6	2,300	8.4	40	180	4.3
	"	11:40 A Dec. 15	55	1	12.01	84.4	1.2	36	8.1	160	190	5.0
Republican River	R - 395.2	9:20 A June 14	59	20	8.01	87.4	1.9	4,300	8.2	160	176	4.0
South of Benkelman U. S. Highway #34	"	9:25 A June 22	596	17	7.41	76.1	5.1	46,000	8.2	3,800	150	4.5
	"	10:50 A June 30	143	23	7.27	83.8	2.2	24,000	8.3	1,100	213	7.4
	"	11:35 A July 9	121	20	7.43	81.0	2.7	46,000	8.4	1,400	181	6.1
	"	1:35 P July 15	114	26	6.62	80.5	2.4	46,000	8.3	700	186	5.0
	"	11:40 A July 21	114	26	6.96	84.7	1.9	23,000	8.5	900	174	3.7
	"	10:20 A July 29	32	26	6.70	81.5	1.7	4,300	8.5	130	183	4.8
	"	11:00 A Aug 4	50	20	7.18	78.3	1.6	4,300	8.5	360	178	4.1
	"	8:35 A Dec. 20	114	0	11.70	80.0	1.2	430	8.3	95	217	5.6
Rock Creek	R - 407.0 Ro.C.-0.5	2:45 P June 8	12	20	7.17	78.2	2.0	2,400	8.3	100	181	2.3
County bridge at Parks	"	7:25 A June 17	16	19	7.28	77.9	2.0	7,500	8.3	160	178	2.6
	"	3:45 P June 24	16	24	6.99	81.9	2.6	43,000	8.2	150	158	1.8
	"	7:30 A July 2	15	17	7.73	79.4	1.7	4,300	8.3	270	169	2.0
	"	8:30 A July 7	13	21	7.43	82.6	2.6	-	8.3	85	169	1.2
	"	6:50 A July 22	15	19	7.21	77.1	3.6	2,300	8.1	120	160	1.5
	"	8:25 A Aug. 5	16	18	7.09	74.3	2.0	4,300	8.1	90	164	1.8
	"	8:15 A Dec.15	17	0	12.13	83.0	2.0	36	8.0	35	182	3.1
Republican River	R - 409.3	2:55 P June 8	52	30	6.71	87.9	1.9	7,500	8.4	190	207	4.8
County Bridge 1 mile west of Parks (old	"	7:35 A June 17	536	20	6.34	69.1	5.1	93,000	7.9	2,500	140	3.5
U.S. Highway #34)												

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Republican River	R - 409.3	3:25 P June 24	214	25	6.87	82.0	1.8	24,000	8.3	500	236	5.9
County bridge - 1 mile west of Parks	"	7:40 A July 2	93	17	8.02	82.3	0.8	7,500	8.4	290	234	6.1
(Old U.S.Highway #34)	"	8:45 A July 7	76	21	7.52	83.6	1.2	4,300	8.5	140	216	4.9
	"	7:05 A July 22	81	19	7.87	84.2	1.5	46,000	8.3	400	207	4.8
	"	8:40 A Aug. 5	30	16	8.01	80.5	0.9	910	8.3	40	212	6.9
	"	8:25 A Dec. 15	100	0	12.20	83.4	1.3	4,600	8.2	120	210	5.5
Buffalo Creek	R - 416.7 Buf.C.-0.3	2:20 P June 8	7.5	27	6.88	85.3	1.7	9,300	8.4	95	184	0.4
4 miles east and 1 mile north of Haigler,	"	7:55 A June 17	11	20	7.30	79.6	1.4	1,500	8.2	110	198	0.9
Nebraska	"	2:55 P June 24	12	25	7.18	85.7	1.2	7,500	8.3	60	194	1.0
	"	7:55 A July 2	12	18	7.66	80.3	1.6	2,300	8.3	140	196	0.5
	"	9:00 A July 7	8.5	21	7.32	81.4	1.7	-	8.2	140	186	0.9
	"	7:30 A July 22	10	19	7.42	79.4	1.1	2,300	8.1	75	186	-
	"	9:00 A Aug. 5	12	16	7.54	75.8	1.0	9,300	8.1	25	185	1.4
	"	8:50 A Dec. 15	9.8	0	12.17	83.2	0.9	73	8.0	20	204	2.5
Arikaree River	R - 421.7 A - 1.1	2:00 P June 8	16	30	6.54	85.7	1.5	2,400	8.4	160	213	7.3
Bridge - U. S. Highway No. 34, west of	"	8:25 A June 17	184	19	6.66	71.2	5.6	>110,000	8.1	2,700	161	5.6
Haigler	"	2:25 P June 24	152	26	6.70	81.5	1.6	210,000	8.3	650	232	10
	"	8:15 A July 2	16	17	8.04	82.5	0.9	4,300	8.4	130	278	14
	"	9:15 A July 7	5.8	22	7.34	83.1	1.2	1,500	8.3	25	284	22
	"	7:55 A July 22	12	19	7.76	83.0	1.7	24,000	8.1	550	194	6.4
	"	9:25 A Aug. 5	1.2	15	7.92	78.0	0.6	7,500	8.2	15	277	31
	"	9:00 A Dec 15	16	0	12.33	84.4	1.1	230	8.1	70	256	9.4
Arikaree River	R - 421.7 A - 13.3	12:30 P June 24	120	28	6.42	81.1	1.3	24,000	8.4	500	234	6.4
Bridge - 14 miles south of Laird,Colo.	"	8:55 A July 2	10	20	7.95	86.7	0.5	2,300	8.4	110	248	8.1
	"	10:05 A July 7	3	25	7.12	85.0	1.2	2,300	8.3	30	225	8.0
	"	8:50 A July 22	8	19	7.98	85.3	1.0	2,400	8.3	80	208	7.5
North Fork Republican	R - 421.7 NFR - 3.0	1:10 P June 3	45	26	6.20	75.4	0.8	4,300	8.4	250	171	4.4
River Bridge 3 miles north-	"	1:50 P June 8	28	27	6.98	86.5	1.9	24,000	8.4	130	249	4.4
west of Haigler	"	8:50 A June 17	250	21	6.05	67.3	4.0	240,000	8.2	1,700	148	1.0
	"	2:05 P June 24	100	23	6.99	80.5	2.2	240,000	8.2	250	216	3.7
	"	8:25 A July 2	70	17	7.81	80.2	1.2	93,000	8.4	150	203	3.7
	"	9:30 A July 7	60	21	7.55	84.0	1.8	-	8.3	160	197	4.3
	"	8:10 A July 22	45	19	7.77	83.1	1.3	23,000	8.2	190	203	4.4
	"	9:45 A Aug. 5	15	15	7.99	78.7	1.0	43,000	8.4	40	262	5.9
	"	9:15 A Dec. 15	75	1	11.79	82.7	1.5	>110,000	8.0	50	189	5.0
North Fork Republican	R -421.7 NFR - 14.7	1:25 P June 8	25	24	7.61	89.2	1.4	24,000	8.4	110	187	3.5
Bridge - U.S.Highway No. 34 - 4 miles	"	9:30 A June 17	230	20	6.46	70.4	4.0	43,000	8.2	1,400	173	1.1
east of Wray,Colo.	"	1:00 P June 24	80	21	7.47	83.1	3.2	460,000	8.2	450	190	2.5
	"	9:25 A July 2	65	18	7.76	81.3	1.7	43,000	8.3	280	186	3.0
	"	10:30 A July 7	50	23	7.53	86.8	1.5	43,000	8.3	130	182	2.5

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1946	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
North Fork Republican	R - 421.7 NFR - 14.7	9:25 A July 22	35	20	7.50	81.8	2.3	43,000	8.1	200	180	1.4
Bridge - U.S.Highway No. 34, 4 miles east	"	10:55 A Aug. 5	8	16	7.69	77.3	1.4	75,000	8.2	70	178	2.0
of Wray, Colo.	"	9:35 A Dec. 15	65	2	11.20	80.8	1.8	46,000	8.0	35	179	3.4
	"											
North Fork Republican	R - 421.7 NFR - 17.5	1:15 P June 8	21	22	7.18	81.3	3.4	110,000	8.4	80	184	3.6
Bridge - 2 miles east of Wray, Colo	"	9:15 A June 17	200	20	6.74	73.5	3.5	43,000	8.2	550	173	0.9
	"	12:40 P June 24	70	20	7.38	80.5	3.6	1,100,000	8.2	250	200	2.6
	"	9:35 A July 2	56	19	7.64	81.7	1.5	39,000	8.3	280	189	2.3
	"	10:45 A July 7	45	24	7.44	87.2	1.2	24,000	8.3	140	179	2.2
	"	9:45 A July 22	33	19	7.57	81.0	3.0	24,000	8.1	150	178	1.9
	"	11:10 A Aug. 5	8	16	7.63	76.7	0.9	110,000	8.2	55	176	2.1
	"	9:55 A Dec. 15	55	3	11.14	82.8	1.6	12,000	8.1	35	181	3.4
	"											
North Fork Republican	R - 421.7 NFR - 19.5	12:40 P June 8	18	21	7.94	88.3	1.6	2,400	8.4	95	183	3.7
State Highway No. 51 at Wray, Colo.	"	10:15 A June 17	180	20	6.32	68.9	3.3	15,000	8.2	600	183	0.5
	"	12:15 P June 24	66	18	7.72	80.9	>7.7	24,000	8.2	600	188	4.1
	"	10:10 A July 2	49	19	7.77	83.1	1.4	4,300	8.3	280	186	2.0
	"	11:00 A July 7	40	21	-	-	2.9	9,300	8.2	130	172	2.3
	"	11:25 A Aug. 5	7	16	8.03	80.7	0.9	2,300	8.2	50	167	1.4
	"	10:15 A Dec. 15	50	3	10.95	81.4	1.4	2,400	8.0	20	176	3.5
North Fork Republican	R - 421.7 NFR - 23.0	12:30 P June 8	16	15	8.02	79.0	0.9	2,400	8.4	80	186	3.5
River Bridge - State	"	9:55 A June 17	150	19	6.23	66.6	3.3	15,000	8.2	320	187	0.3
Highway No. 23 - 3 miles west of	"	11:10 A June 24	60	17	7.98	81.9	2.3	43,000	8.2	500	188	3.9
Wray, Colo	"	9:55 A July 2	45	18	7.92	83.0	1.3	9,100	8.3	290	198	1.9
	"	11:15 A July 7	36	22	7.63	86.4	1.3	2,300	8.2	140	180	1.3
	"	11:40 A Aug. 5	6	16	8.00	80.4	0.9	9,300	8.2	85	175	2.2
	"	10:30 A Dec. 15	40	5	10.78	84.1	1.4	91	8.0	20	148	2.8

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Smoky Hill River	SH - 4.5 L	8:30 A Mar. 8	605	0	12.25	83.8	3.3	43,000	8.2	2,000	149	104
Access road off U. S. Highway Nos. 24 & 40,	"	8:15 A Mar. 15	505	1	11.70	82.2	4.4	7,500	8.3	1,300	201	138
1 mile east of Junction City - Point	"	8:15 A Apr. 1	855	8	9.40	79.3	2.0	7,500	8.3	700	135	103
south of farm of Elmer Gfeller	" R	8:00 A Apr. 14	430	11	8.95	80.8	4.6	2,300	8.3	180	251	298
	"	8:15 A Apr. 30	500	17	7.50	77.1	2.3	4,300	8.4	450	213	252
	"	8:30 A May 21	320	21	8.15	90.7	6.4	4,300	7.9	85	192	322
	"	7:30 A July 9	2,200	26	5.20	63.3	2.2	24,000	7.7	4,000	133	28
	"	7:30 A Aug. 6	1,735	22	6.55	74.2	1.6	15,000	8.2	450	238	189
	"	7:30 A Sept. 3	670	24	6.85	80.1	0.9	9,300	8.1	250	249	279
	"	8:00 A Sept.30	490	15	7.85	77.6	2.2	93,000	8.3	1,000	202	69
	"	8:00 A Nov. 5	1,250	12	7.75	71.5	5.1	23,000	8.3	1,100	184	202
	"	8:20 A Dec. 14	430	3	11.90	88.5	1.6	9,300	8.3	20	301	478
Smoky Hill River	SH - 6.4 C	7:30 A Mar. 8	600	0	12.35	84.5	2.7	9,300	8.1	2,000	145	103
Bridge - East of Junction City	"	7:15 A Mar. 15	500	1	11.70	82.2	4.8	4,300	8.3	1,400	201	140
	"	7:15 A Apr. 1	850	8	9.50	80.1	1.8	4,300	8.3	800	131	105
	"	7:15 A Apr. 14	425	11	8.85	80.0	3.6	2,300	8.3	170	253	298
	"	7:15 A Apr. 30	495	17	7.40	76.1	2.2	15,000	8.4	450	212	250
	"	7:15 A May 21	315	22	7.60	86.2	6.1	2,300	7.9	85	195	327
	"	7:30 A July 9	2,100	26	5.65	68.8	2.2	110,000	7.8	3,400	115	24
	"	6:45 A Aug. 6	1,730	22	6.60	74.8	1.6	43,000	8.2	450	236	194
	"	6:30 A Sept. 3	665	24	6.70	78.6	0.8	43,000	8.1	240	246	286
	"	7:00 A Sept.30	480	15	7.70	76.0	2.5	150,000	8.3	1,000	200	77
	"	7:00 A Nov. 5	1,225	12	7.60	70.2	4.6	93,000	8.3	1,100	195	208
	"	7:30 A Dec.14	420	3	12.00	89.0	0.9	2,300	8.3	20	305	480
Smoky Hill River	SH - 10.9 C	7:00 A Mar. 8	600	0	12.35	84.5	3.1	2,300	8.1	2,000	146	101
Bridge - U.S.Highway No. 77 - South of	"	6:45 A Mar.15	500	1	11.00	77.3	6.5	7,500	8.3	2,000	181	118
Junction City	"	6:45 A Apr. 1	850	8	9.55	80.5	2.2	23,000	8.3	800	138	104
	"	6:45 A Apr. 14	420	11	8.85	80.0	3.5	360	8.3	160	250	302
	"	6:45 A Apr. 30	490	17	7.35	75.5	3.2	9,300	8.4	450	214	222
	"	7:00 A May 21	310	22	7.85	89.0	7.1	2,300	7.9	80	193	342
	"	6:15 A July 9	2,000	26	5.55	67.6	2.1	46,000	8.1	3,800	137	33
	"	6:15 A Aug. 6	1,700	22	6.60	74.8	1.6	23,000	8.2	450	236	196
	"	6:15 A Sept.3	660	24	6.70	78.6	1.3	21,000	8.1	240	250	300
	"	6:30 A Sept.30	470	15	7.80	76.9	2.6	43,000	8.3	1,000	201	131
	"	6:30 A Nov. 5	1,200	12	7.65	70.6	5.0	43,000	8.3	1,000	204	255
	"	7:15 A Dec.14	400	3	11.90	88.5	0.8	2,300	8.3	25	302	488
Lyons Creek	SH - 14.0 Ly.C.-1.5 C	6:30 A May 21	5	20	5.25	57.3	3.1	930	8.2	120	284	38
Bridge - U.S. Highway No. 77, 3 miles south	"	6:00 A July 9	5	25	5.20	62.0	2.0	24,000	8.2	220	220	48
of Junction City	"	6:00 A Aug. 6	125	20	7.35	80.2	1.1	4,300	8.2	70	298	29
	"	5:45 A Sept. 3	50	23	6.10	70.3	1.8	4,300	8.1	80	308	36
	"	6:00 A Sept.30	25	13	8.05	76.0	1.6	2,300	8.3	65	297	33
	"	6:15 A Nov. 5	50	10	5.80	51.2	1.4	230	8.3	65	298	66
	"	6:45 A Dec.14	25	2	13.40	96.8	0.7	430	8.3	20	294	77

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Smoky Hill River	SH - 37.8	7:30 A Apr. 7	540	14	8.25	79.6	1.7	4,300	8.0	250	198	203
Bridge at Chapman	"	10:57 A Apr. 14	410	15	8.57	84.5	3.7	1,500	8.2	180	245	340
	"	6:06 P Apr.20	360	20	10.84	118.2	5.7	1,500	8.2	180	228	394
	"	10:40 A Apr.28	740	20	7.54	82.3	2.6	46,000	8.1	450	192	243
	"	7:03 A May 4	4,300	16	4.99	50.2	4.6	75,000	7.6	5,500	96	91
	"	4:00 A May 18	345	21	8.57	95.3	2.9	4,300	8.1	210	216	253
	"	7:15 A May 25	420	21	6.93	77.1	4.3	-	8.4	160	242	347
	"	4:40 A June 8	1,050	24	5.56	65.3	3.2	-	7.7	5,100	134	36
	"	5:10 A June 22	4,300	19	3.96	42.4	2.4	-	7.5	4,600	136	43
	"	5:25 A July 7	3,050	25	5.35	63.8	2.9	-	7.6	5,500	124	18
	"	5:10 A July 27	14,500	25	2.45	29.2	4.8	24,000	7.4	900	124	10
	"	8:30 A Aug. 5	1,380	22	6.69	74.7	1.4	24,000	8.0	800	244	239
	"	5:30 A Aug.18	1,430	24	6.11	71.7	2.0	43,000	7.6	3,200	157	130
	"	6:10 A Sept.10	560	20	7.68	83.8	2.2	11,000	8.0	160	312	540
	"	6:40 A Sept.14	540	21	7.58	84.4	3.0	11,000	8.3	230	316	558
	"	10:05 A Sept.30	450	17	7.63	78.4	1.7	24,000	7.7	600	169	150
	"	6:40 A Oct.14	325	12	10.02	92.6	5.9	4,300	8.4	180	300	705
	"	6:25 A Nov. 3	1,300	13	8.04	75.8	4.0	23,000	8.1	700	225	375
	"	7:05 A Dec.14	360	4	11.72	89.3	2.0	3,900	8.3	25	312	573
	"	7:00 A Dec.21	335	1	11.90	83.6	1.1	24,000	8.1	20	316	597
Smoky Hill River	SH - 55.4	7:58 A Apr. 7	528	15	8.23	81.0	2.0	2,300	8.3	200	208	226
Bridge at Enterprise	"	11:20 A Apr. 14	390	14	8.26	79.6	3.4	4,300	8.2	130	247	358
	"	5:30 P Apr. 20	352	20	10.49	114.3	4.8	7,500	8.2	130	252	427
	"	11:15 A Apr. 28	670	20	7.72	84.3	4.7	24,000	8.1	390	190	244
	"	7:30 A May 4	4,820	14	6.21	60.0	3.9	24,000	7.6	5,800	130	41
	"	4:25 A May 18	335	21	9.55	106.2	3.2	7,500	8.3	85	227	290
	"	7:35 A May 25	598	22	6.09	69.1	5.2	-	8.3	170	246	432
	"	5:20 A June 8	890	24	6.12	71.7	2.0	-	7.8	2,800	138	80
	"	5:45 A June 22	3,250	20	5.32	58.1	3.2	-	7.5	4,600	124	41
	"	6:05 A July 7	2,760	26	6.12	74.4	2.9	-	8.0	10,000	122	19
	"	5:45 A July 27	9,920	25	2.36	28.2	5.3	9,300	7.5	1,400	130	18
	"	8:00 A Aug. 5	1,450	22	6.84	77.4	1.4	46,000	7.9	600	242	271
	"	6:00 A Aug.18	1,360	24	6.44	75.4	1.8	46,000	7.8	3,300	159	185
	"	7:10 A Sept.14	516	21	7.21	80.2	2.9	46,000	8.3	130	305	602
	"	7:00 A Oct.14	319	12	10.20	94.3	4.9	15,000	8.0	160	286	790
	"	6:50 A Nov. 3	1,280	13	8.18	77.2	5.2	93,000	8.0	2,000	171	225
	"	7:25 A Dec. 21	335	1	12.31	86.5	1.9	9,300	8.1	25	315	623
Smoky Hill River	SH - 61.0	8:55 A Apr. 7	520	14	8.31	80.1	2.7	4,600	8.3	190	219	270
County Bridge 2 miles east of Abilene	"	1:30 P Apr. 14	385	17	9.40	96.5	5.0	2,900	8.2	150	244	413
	"	4:17 P Apr. 20	350	20	10.74	117.1	5.8	2,300	8.4	130	258	466
	"	11:55 A Apr. 28	650	20	7.03	76.7	3.0	2,400	8.2	280	195	205
	"	8:33 A May 4	4,750	16	5.58	56.1	3.4	24,000	7.6	5,800	87	38
	"	4:50 A May 18	330	21	8.18	91.0	5.2	24,000	8.2	110	234	333

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1949	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Smoky Hill River	SH - 61.0	7:55 A May 25	615	23	7.58	87.3	5.8	-	8.4	200	256	353
County Bridge 2 miles east of Abilene	"	5:40 A June 8	870	24	6.26	73.4	2.5	-	7.6	3,600	136	70
	"	6:20 A June 22	2,950	20	5.44	59.3	4.0	-	7.5	4,800	140	33
	"	6:30 A July 7	2,450	26	6.09	74.1	3.3	-	7.6	5,500	147	17
	"	6:25 A Aug. 18	1,330	25	6.68	79.7	1.8	46,000	7.8	3,100	163	195
	"	7:30 A Sept.14	500	21	7.87	87.6	2.8	46,000	8.2	130	311	636
	"	7:20 A Oct. 14	316	13	9.86	93.0	4.0	9,300	8.5	160	323	804
	"	7:05 A Nov. 3	1,260	13	8.11	76.5	4.3	93,000	7.7	2,300	152	182
	"	7:40 A Dec. 21	330	1	12.48	87.6	1.5	15,000	8.1	20	308	611
Smoky Hill River	SH - 64.8	8:27 A Apr. 7	510	16	8.28	83.2	1.8	4,300	8.3	200	206	248
Bridge South of Abilene - State	"	11:50 A Apr.14	380	14	9.59	92.5	4.7	2,300	8.2	130	250	378
Highway No. 15	"	4:44 P Apr. 20	345	19	8.86	94.9	4.2	360	8.3	130	254	454
	"	12:20 P Apr. 28	630	19	6.98	74.7	2.9	24,000	8.2	1,000	155	204
	"	8:00 A May 4	4,700	14	5.20	50.2	3.2	23,000	7.6	5,600	89	401
	"	5:00 A May 18	320	21	8.32	92.6	2.0	360	8.2	130	238	351
	"	8:10 A May 25	625	22	6.80	77.1	5.1	-	8.4	190	256	243
	"	6:00 A June 8	850	24	4.46	52.3	1.3	-	7.6	2,000	160	114
	"	6:35 A June 22	2,850	19	3.26	34.9	2.4	-	7.5	4,200	138	45
	"	6:50 A July 7	2,100	27	4.92	60.9	2.8	-	7.6	4,800	107	18
	"	6:15 A July 27	8,000	25	2.16	25.8	7.5	46,000	7.6	3,600	155	20
	"	6:45 A Aug. 18	1,300	25	5.88	70.2	1.9	24,000	7.8	2,300	156	185
	"	7:55 A Sept.14	490	21	8.07	89.7	2.6	4,300	8.3	130	309	656
	"	7:40 A Oct. 14	314	13	10.99	103.6	3.8	4,300	7.9	170	290	860
	"	7:25 A Nov. 3	1,250	12	6.44	59.4	4.0	43,000	8.0	2,000	159	180
	"	7:55 A Dec. 21	330	1	13.59	95.4	1.2	1,500	8.1	25	311	638
Smoky Hill River	SH 74.5	9:12 A Apr. 7	500	16	8.25	82.9	2.7	4,600	8.3	260	220	271
County Bridge - 2½ miles west of	"	1:37 P Apr. 14	375	17	9.53	97.8	5.6	1,500	8.2	160	240	403
Abilene	"	4:08 P Apr. 20	340	21	10.52	117.2	4.8	4,300	8.3	180	247	468
	"	12:45 P Apr. 28	500	20	6.51	71.0	4.7	43,000	8.0	1,100	155	229
	"	8:44 A May 4	4,650	14	5.52	53.2	3.4	23,000	7.6	5,600	84	43
	"	5:40 A May 18	310	21	8.14	90.7	2.8	2,300	8.2	260	248	401
	"	8:30 A May 25	600	21	6.52	72.6	4.5	-	8.3	1,600	181	204
	"	6:20 A June 8	830	24	5.16	60.5	3.3	-	7.9	6,500	125	128
	"	7:00 A June 22	2,350	20	4.34	47.3	3.0	-	7.6	5,000	168	38
	"	7:25 A July 7	1,650	26	5.07	61.7	2.9	-	7.6	5,500	148	26
	"	6:50 A July 27	5,500	25	3.23	38.6	2.7	46,000	7.4	3,600	117	24
	"	7:25 A Aug. 18	1,270	25	5.75	68.6	2.3	110,000	7.7	3,200	154	185
	"	8:25 A Sept. 14	480	21	7.50	83.5	2.8	24,000	8.2	300	315	662
	"	8:00 A Oct. 14	312	13	9.00	84.9	3.3	9,300	8.4	150	333	872
	"	7:45 A Nov. 3	1,240	12	6.57	60.6	5.0	23,000	8.1	2,100	228	370
	"	8:15 A Dec. 21	328	1	12.18	85.4	1.3	11,000	8.1	25	322	693

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Smoky Hill River	SH - 85.3	9:38 A Apr. 7	470	14	8.48	81.8	3.6	>11,000	8.3	240	220	272
Bridge below confluence of Smoky Hill and	"	3:54 P Apr. 20	325	21	10.44	116.2	4.7	4,300	8.4	240	280	399
Solomon Rivers	"	1:00 P Apr. 28	425	20	7.11	77.6	3.9	210,000	8.0	550	175	350
	"	8:58 A May 4	3,750	16	5.86	59.0	4.1	23,000	7.6	4,900	101	66
	"	6:00 A May 18	295	19	7.81	83.4	3.1	9,300	8.2	230	262	402
	"	9:47 A May 25	580	20	6.76	73.7	5.2	-	7.9	1,500	131	182
	"	6:35 A June 8	710	24	5.49	64.4	3.9	-	8.0	8,500	144	115
	"	7:15 A June 22	2,150	20	4.54	49.6	3.7	-	7.8	5,400	132	34
	"	7:40 A July 7	1,440	25	5.14	61.4	3.0	-	7.6	4,900	115	28
	"	7:15 A July 27	2,200	25	4.08	48.7	3.3	46,000	7.4	3,600	150	36
	"	7:45 A Aug. 18	1,450	24	5.95	69.7	2.4	110,000	7.7	2,200	155	190
	"	8:50 A Sept.14	480	21	7.56	84.2	2.7	15,000	8.1	300	321	622
	"	8:20 A Oct. 14	210	11	9.22	83.3	3.3	4,300	8.3	140	330	780
	"	8:00 A Nov. 3	1,230	12	5.82	53.7	8.0	150,000	7.7	2,000	150	200
	"	8:30 A Dec. 21	326	1	12.00	84.3	1.6	4,300	8.0	25	304	628
	"											
Smoky Hill River	SH - 94.1	9:55 A Apr. 7	250	14	8.85	85.3	2.1	930	8.3	270	251	163
Bridge 5 miles Southwest of Solomon	"	3:00 P Apr. 20	165	20	11.80	128.7	5.6	21,000	8.4	120	226	407
	"	1:15 P Apr. 28	190	20	7.25	79.1	4.1	93,000	8.0	600	180	297
	"	9:34 A May 4	180	17	6.27	64.4	5.4	150,000	8.0	550	204	308
	"	6:15 A May 18	125	19	7.41	79.3	3.4	9,100	8.2	170	257	334
	"	9:05 A May 25	180	20	8.04	87.6	5.8	-	8.3	190	263	434
	"	7:20 A June 8	250	24	5.62	65.8	2.7	-	7.9	1,800	179	458
	"	7:15 A June 22	1,475	20	3.94	42.9	3.0	-	7.5	5,600	113	34
	"	8:00 A July 7	500	26	4.51	54.8	3.1	-	7.8	5,000	141	30
	"	7:35 A July 27	650	25	4.80	57.3	2.6	46,000	7.5	2,900	170	43
	"	8:00 A Aug. 18	820	24	5.98	70.1	2.2	24,000	7.7	900	156	150
	"	7:40 A Sept.10	200	20	6.93	75.5	3.0	>110,000	7.9	310	255	325
	"	9:10 A Sept.14	270	21	7.15	79.6	3.3	1,100,000	8.1	280	263	418
	"	11:00 A Sept.30	160	17	7.01	72.0	4.1	46,000	7.8	330	238	442
	"	8:40 A Oct. 14	175	11	8.11	73.5	3.9	240,000	8.2	150	278	586
	"	8:15 A Nov. 3	650	12	5.90	54.4	5.1	430,000	7.7	2,400	122	176
	"	7:50 A Dec. 14	210	4	11.21	85.4	1.5	46,000	8.1	30	256	419
	"	8:45 A Dec. 21	190	1	11.67	81.9	2.1	9,300	7.9	30	272	455
Smoky Hill River	SH - 105.8	10:20 A Apr. 7	225	16	7.31	73.5	4.7	>110,000	8.0	200	200	256
1st bridge below confluence of Saline and	"	2:40 P Apr. 20	145	20	8.25	90.0	5.8	150,000	8.0	100	231	378
Smoky Hill Rivers	"	1:45 P Apr. 28	170	21	5.96	66.3	4.9	240,000	8.0	220	200	355
	"	9:56 A May 4	160	18	6.02	63.1	4.0	150,000	7.9	600	238	568
	"	6:35 A May 18	115	19	7.56	80.8	2.9	15,000	8.2	200	256	357
	"	9:27 A May 25	115	21	5.86	65.3	5.6	-	8.4	150	276	391
	"	7:45 A June 8	180	25	5.10	60.8	4.5	-	7.9	1,000	181	336
	"	7:50 A June 22	800	20	3.36	36.7	2.9	-	7.6	4,600	110	24
	"	8:20 A July 7	415	27	4.93	61.0	3.9	-	7.8	5,000	132	27
	"	8:10 A July 27	465	25	4.81	57.4	2.6	460,000	7.6	3,600	115	43

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Smoky Hill River	SH - 105.8	7:10 A Aug. 5	550	22	4.45	50.4	4.0	240,000	7.7	6,200	138	152
1st bridge below confluence of Saline	"	8:20 A Aug. 18	580	25	5.20	62.1	2.4	460,000	7.7	1,000	176	140
and Smoky Hill Rivers	"	9:40 A Sept. 14	165	21	6.26	69.6	4.3	110,000	8.1	280	251	346
	"	11:30 A Sept. 30	125	17	6.72	69.1	3.6	46,000	7.8	300	245	338
	"	9:00 A Oct. 14	155	11	7.88	71.2	3.0	46,000	8.0	120	266	484
	"	8:30 A Nov. 3	550	13	6.26	56.6	5.2	240,000	7.7	2,300	128	202
	"	8:10 A Dec. 14	160	3	10.74	79.8	2.1	24,000	8.0	25	252	383
	"	9:00 A Dec. 21	140	1	10.33	72.6	1.5	46,000	7.9	25	264	370
Smoky Hill River												
County bridge - 3 miles east of Salina	SH - 112.7	6:55 A May 18	50	22	4.60	52.2	2.0	43,000	8.3	75	232	154
	"	9:47 A May 25	55	21	0.00	0.0	16.9	-	7.9	40	269	156
	"	7:55 A June 8	42	25	0.00	0.0	12.6	-	8.2	35	291	136
	"	8:00 A June 22	580	20	1.93	21.0	11.6	-	7.5	2,400	100	30
	"	9:35 A July 7	65	27	1.28	15.9	7.5	-	7.7	90	206	50
	"	8:35 A July 27	165	26	3.06	37.2	7.0	>1,100,000	7.7	600	132	32
	"	6:00 A Aug. 5	210	22	3.95	44.7	3.3	2,400,000	7.8	280	180	82
	"	8:45 A Aug. 18	200	26	4.31	52.4	3.4	460,000	7.6	400	130	60
	"	8:15 A Sept. 10	110	21	3.68	41.0	4.1	23,000	7.7	75	210	81
	"	10:15 A Sept. 14	85	23	3.73	43.0	6.1	1,100,000	8.0	110	223	98
	"	12:00 M Sept. 30	80	19	3.77	40.3	3.3	460,000	7.8	120	227	74
	"	9:30 A Oct. 14	78	14	3.08	29.7	5.5	2,400,000	7.6	30	228	108
	"	9:00 A Nov. 3	425	13	6.36	57.4	5.0	240,000	7.7	2,000	100	28
	"	8:25 A Dec. 14	90	4	6.65	50.6	>16.1	1,100,000	7.7	35	217	108
	"	9:35 A Dec. 21	85	1	6.18	43.4	19.0	240,000	7.3	25	224	100
Smoky Hill River	SH - 120.4	11:55 A Apr. 5	120	16	7.05	70.8	7.1	460,000	7.7	200	136	113
North State Road bridge east of Salina	"	6:35 A Apr. 12	81	14	8.41	81.1	1.8	36,000	8.1	160	169	94
	"	2:20 P Apr. 20	72	22	8.26	93.6	3.4	3,900	7.9	220	174	149
	"	2:00 P Apr. 28	68	21	3.52	39.2	4.0	240,000	8.0	210	141	103
	"	10:17 A May 4	75	17	7.46	76.5	3.1	43,000	7.7	1,300	21	103
	"	7:15 A May 18	44	22	4.61	52.3	2.0	23,000	8.1	75	206	126
	"	9:55 A May 25	50	22	5.77	65.4	3.0	-	8.3	180	225	158
	"	8:10 A June 8	37	28	2.38	30.1	4.3	-	8.4	120	242	100
	"	8:15 A June 22	550	20	5.68	61.9	3.9	-	7.7	3,200	107	32
	"	9:50 A July 7	55	27	5.52	68.4	4.7	-	8.3	220	196	36
	"	8:50 A July 27	155	26	6.27	76.4	2.8	46,000	7.8	380	127	25
	"	6:15 A Aug. 5	200	22	6.95	78.8	2.0	9,300	7.9	450	167	78
	"	9:50 A Aug. 18	190	26	6.57	79.9	1.2	15,000	7.7	400	126	50
	"	8:35 A Sept. 10	100	20	7.57	82.5	2.6	110,000	8.0	140	196	66
	"	10:30 A Sept. 14	80	22	7.70	87.2	2.2	15,000	8.1	170	207	62
	"	12:15 P Sept. 30	76	17	8.15	83.7	1.2	9,300	8.0	140	212	62
	"	9:45 A Oct. 14	73	12	9.34	86.1	1.7	9,300	8.0	95	210	64
	"	9:10 A Nov. 3	375	13	8.65	81.6	4.4	93,000	7.7	2,500	108	36
	"	8:40 A Dec. 14	80	3	12.45	92.4	2.2	4,600	8.0	20	202	103
	"	9:50 A Dec. 21	80	1	12.96	91.0	1.8	24,000	8.0	25	211	88

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Smoky Hill River	SH 124.0	11:35 A Apr. 5	120	14	8.96	86.5	1.1	910	7.8	260	120	114
Iron Avenue bridge at Salina	"	6:48 A Apr. 12	81	14	10.40	100.3	3.6	750	8.1	120	165	109
	"	1:48 P Apr. 20	72	21	7.06	78.5	2.8	230	7.9	160	168	144
	"	2:20 P Apr. 28	68	21	7.88	87.7	2.3	2,400	7.9	220	140	89
	"	10:30 A May 4	75	16	6.58	66.3	2.4	46,000	7.6	550	34	105
	"	7:35 A May 18	44	22	6.14	69.4	1.5	2,300	8.1	70	229	126
	"	10:13 A May 25	50	22	5.09	57.7	2.4	-	8.3	180	232	152
	"	8:20 A June 8	37	26	3.27	39.8	4.1	-	8.4	35	194	101
	"	8:25 A June 22	550	20	4.64	50.6	3.5	-	7.7	2,400	155	55
	"	9:05 A July 7	55	27	6.49	80.3	3.4	-	8.3	190	166	37
	"	9:05 A July 27	155	26	5.65	68.7	1.4	24,000	7.8	500	119	33
	"	6:40 A Aug. 5	200	22	6.10	69.1	1.2	910	7.9	500	164	82
	"	9:20 A Aug. 18	190	25	5.87	72.1	0.8	9,300	7.9	380	132	50
	"	8:50 A Sept.10	100	21	7.66	85.2	2.5	430	8.2	120	194	68
	"	10:50 A Sept.14	80	22	7.06	80.0	1.6	2,400	8.2	140	211	70
	"	12:30 P Sept.30	76	18	7.97	83.7	0.5	4,600	8.1	95	210	70
	"	9:25 A Nov. 3	35	13	6.84	64.5	4.0	43,000	7.6	2,700	93	21
	"	10:00 A Oct.14	74	12	9.30	85.7	0.5	24,000	8.0	75	200	86
	"	8:55 A Dec. 14	75	3	13.60	101.0	2.1	430	8.1	20	184	106
	"	10:05 A Dec. 21	71	1	14.39	101.0	1.3	2,400	8.0	25	208	89
Smoky Hill River	SH - 132.0	11:02 Apr. 5	120	14	9.19	88.6	1.5	430	7.9	290	124	110
County bridge - 2 miles south of Salina	"	7:10 A Apr. 12	81	14	8.83	85.2	2.4	430	8.1	80	163	126
	"	1:30 P Apr. 20	72	21	8.37	93.2	3.5	150	8.0	220	172	144
	"	2:45 P Apr. 28	70	22	7.47	84.7	1.6	430	8.0	900	161	66
	"	10:50 A May 4	78	17	8.25	84.7	2.1	4,600	7.9	450	111	182
	"	8:10 A May 18	44	22	7.83	88.7	2.2	930	8.2	95	218	121
	"	10:40 A May 25	51	21	8.05	89.6	2.9	-	8.3	200	220	163
	"	8:50 A June 8	37	24	7.00	82.2	1.8	-	8.3	120	220	98
	"	8:50 A June 22	502	20	4.61	50.3	3.4	-	7.6	1,900	65	34
	"	9:35 A July 7	53	27	6.31	78.2	4.0	-	8.3	160	198	43
	"	9:25 A July 27	149	26	6.33	76.9	1.7	9,300	7.8	550	161	39
	"	10:10 A Aug.18	188	27	6.43	79.7	1.3	2,900	7.9	450	136	68
	"	9:10 A Sept.10	96	20	7.95	86.6	2.6	4,300	8.1	110	197	63
	"	11:40 A Sept.14	80	22	8.01	90.6	2.0	2,400	8.0	150	208	69
	"	12:50 P Sept.30	68	18	8.66	90.8	1.1	430	8.2	95	204	70
	"	10:15 A Oct. 14	67	12	9.76	90.1	1.2	91	8.0	35	204	77
	"	9:45 A Nov. 3	288	13	7.60	71.7	3.8	240,000	7.7	3,000	98	21
	"	9:20 A Dec. 14	67	3	12.20	90.6	1.6	230	7.9	25	187	101
	"	10:20 A Dec. 21	63	1	12.71	89.3	0.9	140	8.0	20	210	91
Smoky Hill River	SH - 167.4	9:00 A May 18	36	20	7.81	85.3	1.9	4,300	8.2	70	215	175
County bridge 2 miles east of Lindsborg	"	11:20 A May 25	35	20	8.62	94.0	2.3	-	8.4	150	197	198
	"	9:25 A June 8	26	25	5.65	67.5	1.6	-	8.1	75	213	181
	"	9:25 A June 22	102	21	6.41	71.3	4.0	-	7.6	3,400	84	18

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Smoky Hill River	SH - 167.4	10:10 A July 7	32	27	6.76	83.7	5.0	-	8.4	130	193	100
County bridge 2 miles east of	"	10:05 A July 27	115	26	6.54	79.4	1.6	7,500	7.8	400	151	76
Lindsborg	"	10:50 A Aug. 18	571	26	6.63	80.6	1.9	9,300	7.9	450	128	74
	"	7:10 A Sept.21	58	22	6.12	69.3	1.0	1,500	7.9	55	189	65
	"	7:10 A Oct. 19	60	9	9.42	81.3	1.1	11,000	7.9	15	177	84
	"	6:50 A Nov. 2	200	-	6.75	-	8.1	>110,000	7.7	2,600	88	20
	"	7:05 A Dec. 8	57	1	12.10	85.0	2.0	2,400	7.9	10	184	98
Smoky Hill River	SH 170.9	10:07 A Apr. 5	75	14	9.24	89.1	1.2	1,500	8.0	160	125	130
Bridge - U.S. Highway No. 81	"	7:55 A Apr. 12	68	13	9.14	86.2	2.5	2,400	8.2	50	148	158
(Lindsborg)	"	12:45 P Apr. 20	67	18	8.89	93.2	4.1	430	8.0	50	145	173
	"	3:10 P Apr. 28	49	21	8.72	97.2	2.6	2,400	8.1	160	180	170
	"	11:23 A May 4	50	17	9.04	92.8	2.1	930	7.9	250	262	150
	"	8:45 A May 18	34	20	7.55	82.3	1.6	4,600	8.3	140	204	185
	"	11:32 A May 25	30	20	8.04	87.8	2.3	-	8.3	200	215	207
	"	9:35 A June 8	24	25	6.13	73.3	0.9	-	8.2	85	207	180
	"	9:35 A June 22	93	21	6.52	72.6	3.4	-	7.7	800	84	9
	"	10:25 A July 7	30	28	6.41	80.8	3.9	-	8.3	90	183	101
	"	10:25 A July 27	113	27	6.82	84.4	1.7	15,000	8.0	400	152	80
	"	11:00 A Aug. 18	634	26	6.06	73.7	2.1	15,000	7.9	700	128	77
	"	7:30 A Sept.21	56	22	7.09	80.3	1.1	750	7.9	55	182	77
	"	7:30 A Oct.19	54	8	10.15	85.6	1.0	1,500	7.9	15	175	84
	"	7:05 A Nov. 2	190	-	7.37	-	6.5	>110,000	7.7	2,100	89	19
	"	7:25 A Dec. 8	53	1	12.52	88.0	1.3	4,600	7.9	15	182	100
Smoky Hill River	SH - 192.5	9:43 A Apr. 5	61	13	9.25	87.2	1.2	430	7.9	160	124	139
Bridge at Marquette	"	8:22 A Apr. 12	58	12	9.33	86.1	2.4	390	8.2	35	140	169
	"	12:20 P Apr. 20	56	18	9.87	103.5	5.1	230	8.0	55	125	197
	"	3:45 P Apr. 28	34	21	10.38	115.3	4.4	430	8.0	25	148	204
	"	11:50 A May 4	35	16	10.34	104.0	1.7	430	8.0	25	198	155
	"	9:30 A May 18	21	19	7.20	77.0	1.5	1,500	8.1	60	184	220
	"	11:55 A May 25	19	20	8.55	93.3	1.6	-	8.3	55	189	279
	"	10:10 A June 8	14	24	5.60	65.7	1.1	-	8.0	90	189	238
	"	10:15 A June 22	25	22	6.47	73.3	2.8	-	7.7	400	109	82
	"	11:00 A July 7	20	27	7.12	88.2	1.6	-	8.4	75	186	162
	"	10:50 A July 27	100	27	6.76	83.8	-	15,000	7.7	200	135	87
	"	11:40 A Aug. 18	870	24	6.54	76.5	1.8	46,000	7.7	130	116	81
	"	8:10 A Sept.21	48	23	6.84	78.8	1.0	430	7.9	30	168	84
	"	7:55 A Oct. 19	46	8	9.54	80.4	1.3	150	7.9	15	160	92
	"	7:35 A Nov. 2	100	-	7.67	-	3.5	46,000	7.9	190	141	77
	"	7:55 A Dec. 8	47	1	11.95	84.0	1.7	750	7.9	25	167	114
Smoky Hill River	SH - 207.2	9:15 A Apr. 5	54	12	9.91	91.6	1.6	91	7.9	190	113	145
Bridge below Kanopolis Dam	"	8:47 A Apr. 12	53	13	9.86	93.1	2.9	430	8.2	50	133	173
	"	11:50 A Apr. 20	51	19	9.22	98.7	4.6	36	8.0	55	117	207

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Smoky Hill River	SH - 207.2	4:10 P Apr. 28	27	20	8.45	92.2	3.2	930	8.0	50	130	230
Bridge below Kanopolis Dam	"	12:08 P May 4	27	19	9.03	96.5	2.4	230	7.9	50	138	140
	"	10:05 A May 18	14	21	9.60	106.8	1.2	230	8.2	25	156	266
	"	12:22 P May 25	14	20	8.92	97.3	1.3	-	8.4	25	161	279
	"	10:35 A June 8	9	26	8.62	104.8	1.2	-	8.4	40	186	314
	"	10:40 A June 22	15	25	7.23	86.3	2.3	-	7.9	550	156	228
	"	11:25 A July 7	15	27	9.28	115.1	1.8	-	8.3	35	160	201
	"	11:30 A July 27	94	27	7.76	96.3	2.9	360	7.7	55	96	98
	"	13:05 P Aug. 18	870	24	6.91	81.1	1.6	4,300	7.6	55	116	70
	"	8:45 A Sept.21	44	23	7.91	91.2	1.6	1,100	7.9	35	148	75
	"	8:45 A Oct. 19	39	8	9.77	82.4	1.4	230	8.0	15	142	95
	"	8:10 A Nov. 2	46	-	9.30	-	1.3	210	7.9	20	148	102
	"	8:20 A Dec. 8	41	2	11.66	84.2	1.4	< 30	7.9	25	147	125
Smoky Hill River	SH - 228.5	8:45 A Apr. 5	63	11	9.97	90.1	1.8	3,900	8.2	70	171	401
Bridge, 2 miles southeast of Kanopolis	"	9:20 A Apr. 12	48	10	10.13	89.5	1.8	12,000	8.2	30	176	445
	"	11:15 A Apr. 20	37	19	9.81	104.9	3.2	< 360	8.2	20	174	520
	"	5:00 P Apr. 28	69	22	8.83	100.0	3.6	430	8.1	45	141	333
	"	1:13 P May 4	95	19	8.84	94.6	3.2	11,000	7.9	500	310	122
	"	10:50 A May 18	22	24	8.27	97.0	1.7	2,400	8.2	40	192	459
	"	1:07 P May 25	19	24	7.40	86.8	-	-	8.4	35	187	368
	"	11:15 A June 8	23	27	8.84	109.5	3.4	-	8.0	90	155	598
	"	11:20 A June 22	75	26	6.79	82.7	5.1	-	8.0	1,000	118	241
	"	12:15 P July 7	360	29	6.09	78.4	2.5	-	8.0	800	136	37
	"	12:15 P July 27	280	29	6.05	77.9	1.1	9,300	8.0	700	138	91
	"	1:00 P Aug. 18	390	28	6.27	79.2	1.5	24,000	7.9	1,900	128	30
	"	9:40 A Sept.21	38	23	7.92	89.7	2.5	2,400	8.0	140	186	464
	"	9:25 A Oct. 19	35	7	10.35	85.2	1.6	>11,000	7.9	8	198	604
	"	9:00 A Nov. 2	56	-	8.59	-	3.9	24,000	8.0	45	158	486
	"	9:05 A Dec. 8	45	0	12.35	84.4	1.6	24,000	8.0	65	192	604
Smoky Hill River	SH - 235.2	8:02 A Apr. 5	62	12	9.74	89.9	2.2	1,500	8.2	65	173	416
Bridge between Kanopolis & Ellsworth State Highway No. 14	"	9:40 A Apr. 12	47	12	10.12	93.6	1.8	9,300	8.2	30	177	475
	"	10:55 A Apr. 20	36	19	11.14	119.2	1.3	910	8.2	25	178	522
	"	5:20 P Apr. 28	62	22	9.05	102.4	3.0	4,300	8.2	60	143	349
	"	1:31 P May 4	95	19	9.14	97.7	3.0	9,300	7.9	400	141	560
	"	11:15 A May 18	22	24	9.34	109.4	2.4	46,000	8.2	40	194	518
	"	1:20 P May 25	18	25	13.00	155.2	4.9		8.4	35	180	358
	"	11:30 A June 8	22	27	8.84	109.5	3.5		8.4	85	173	628
	"	11:40 A June 22	64	25	7.31	87.3	5.0		7.9	1,000	128	234
	"	12:30 P July 7	334	28	6.01	76.0	2.1	-	8.1	900	138	42
	"	12:35 P July 27	273	29	5.91	76.1	1.3	24,000	7.9	800	137	95
	"	1:25 P Aug. 18	384	28	6.37	80.5	1.9	24,000	7.9	1,400	132	35
	"	10:05 A Sept.21	36	23	8.45	95.8	2.8	930	8.2	90	188	488
	"	9:40 A Oct. 19	28	9	11.79	101.7	1.5	>11,000	8.1	7	200	627

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Smoky Hill River	SH - 235.2	9:25 A Nov. 2	50	-	9.10	-	3.4	4,300	7.9	90	166	516
Bridge between Kanopolis & Ellsworth	"	9:20 A Dec. 8	42	1	12.65	88.9	1.1	11,000	8.0	15	195	618
State Highway No. 14												
Smoky Hill River	SH - 238.0	12:50 P July 27	273	29	6.27	80.7	1.4	15,000	8.0	650	144	101
County bridge - Ellsworth, Kansas	"	6:35 A Aug. 11	295	24	6.43	75.4	1.3	15,000	7.8	2,500	113	58
	"	8:00 A Sept.16	50	20	7.08	77.3	2.0	2,400	8.0	120	184	408
	"	10:50 A Sept.21	41	24	7.82	91.7	2.6	230	8.2	85	186	502
	"	10:00 A Oct. 19	25	9	10.35	89.4	1.5	430	8.2	10	198	640
	"	9:40 A Nov. 2	46	-	9.17	-	3.3	1,500	7.9	110	163	501
	"	9:35 A Dec. 8	38	1	12.80	89.9	1.0	91	7.9	25	193	620
	"	7:00 A Dec. 15	37	0	11.79	80.5	1.4	240	7.9	15	209	586
Smoky Hill River	SH - 249.8	7:15 A Aug. 11	296	24	6.49	76.1	1.0	24,000	7.9	1,800	117	69
County bridge - 3 miles east and 2½	"	8:35 A Sept.16	40	20	7.90	86.2	2.1	73	8.0	90	178	454
miles south of Wilson	"	11:15 A Sept.21	33	25	8.05	96.1	2.6	930	8.1	180	176	581
	"	11:20 A Oct. 19	20	12	10.33	95.4	1.2	230	8.1	160	191	800
	"	10:10 A Nov. 2	41	-	9.19	-	3.4	24,000	7.9	120	146	510
	"	9:55 A Dec. 8	33	1	12.83	90.2	0.9	30	8.1	100	191	676
	"	7:50 A Dec. 15	32	1	11.83	83.1	4.0	93	8.1	15	200	678
Smoky Hill River	SH - 254.6	7:35 A Aug. 11	300	24	6.69	78.4	1.3	2,300	7.9	1,800	120	68
County bridge, 2½ miles south of	"	8:55 A Sept.16	40	20	8.10	88.3	2.1	430	8.1	100	178	512
Wilson	"	11:35 A Sept.21	32	25	8.15	97.3	2.4	230	8.2	35	181	620
	"	11:35 A Oct. 19	17	11	10.73	97.1	1.0	91	8.2	4	188	864
	"	10:40 A Nov. 2	38	-	9.73	-	3.0	4,300	8.0	130	161	712
	"	10:20 A Dec. 8	30	1	13.20	92.7	0.7	91	8.1	20	205	702
	"	8:20 A Dec. 15	29	1	12.04	84.6	2.3	43	8.0	20	203	702
Smoky Hill River	SH - 284.1	9:30 A Aug. 4	170	20	6.88	75.3	5.5	46,000	7.9	800	126	205
County bridge, 3½ miles east and 6	"	12:15 P Sept.21	22	27	8.13	100.5	1.3	230	8.2	15	188	749
miles south of Russell	"	12:20 P Oct. 19	15	14	11.90	115.0	2.5	930	7.8	15	200	1,032
	"	11:00 A Dec. 8	22	2	12.70	91.7	0.8	< 30	8.1	15	205	710
Fossil Creek	SH - 285.7 F.C. - 1.4	10:05 A Aug. 4	4	19	5.53	59.2	> 5.5	> 110,000	7.6	1,300	119	75
County bridge - 1½ miles east and	"	12:30 P Sept.21	0.5	24	10.91	128.1	5.0	24,000	8.2	45	241	290
5 miles south of Russell	"	12:35 P Oct. 19	0.5	12	14.53	134.2	3.7	360	8.7	40	201	190
	"	11:30 A Nov. 2	1	-	8.71	-	6.5	930	8.1	40	212	197
	"	11:15 A Dec.8	0.5	2	16.76	121.0	4.4	< 300	8.5	25	242	226
Big Creek	SH - 292.1 Bi.C. - 2.2	10:30 A Aug. 4	38	22	8.22	93.1	7.5	2,300	8.5	270	202	230
County bridge, 3½ miles west of Russell	"	11:15 A Aug. 23	26	23	7.33	74.5	2.4	2,400	7.9	370	134	135
and 6 miles south of Highway 40	"	12:45 P Sept.21	2.7	20	8.91	97.2	3.1	240	8.0	55	185	1,060
	"	11:30 A Oct. 7	2.6	11	9.86	89.0	3.0	430	8.0	35	230	1,460
	"	1:30 P Dec. 9	5	3	16.78	124.4	3.3	73	8.4	10	236	672

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Intake Russell Water		9:05 A Aug. 4	-	20	7.73	84.3	5.4	24,000	7.9	1,200	210	12
Plant		12:00 N Aug. 23	-	24	8.10	94.9	3.0	2,800	7.9	500	114	10
		1:30 P Sept. 21	-	23	7.60	87.5	2.9	36	8.2	100	220	29
		12:05 P Oct. 7	-	12	9.64	88.9	2.0	930	7.8	450	104	10
		12:45 P Oct. 19	-	12	10.16	93.7	1.3	1,100	7.9	280	105	12
		11:50 A Nov. 2	-	-	9.80	-	1.8	23	8.1	170	115	13
		11:35 A Dec. 8	-	3	12.09	89.7	1.4	43	8.1	15	252	41
		2:00 P Dec. 9	-	4	12.82	97.7	2.2	43	8.3	15	245	38
Big Creek	SH - 292.1 Bi.C.-34.4	12:05 P Aug. 4	34	20	6.67	72.7	6.0	21,000	7.7	1,600	102	5.3
County bridge - 2 miles east and 2½	"	10:20 A Aug. 23	26	21	6.85	76.1	3.1	4,300	8.4	300	180	11
miles south of Hays	"	10:20 A Oct. 7	2.6	9	10.64	92.0	3.9	930	8.3	95	272	52
	"	12:30 P Dec. 9	5	2	12.49	90.2	2.2	2,400	8.0	10	248	32
Big Creek	SH - 292.1 Bi.C.-36.6	9:50 A Aug. 23	25	23	5.75	66.2	3.4	2,300	8.4	240	187	12
No bridge - 1 mile east and 2 miles	"	12:15 P Dec. 9	5	1	11.51	80.9	3.8	2,400	7.8	10	252	34
south of Hays												
Big Creek	SH - 292.1 Bi.C.-39.6	12:25 P Aug. 4	33	20	6.09	66.4	4.8	24,000	7.6	1,100	98	4.7
County bridge - 1 mile south of Hays	"	10:05 A Aug. 23	24	23	6.90	79.6	4.0	46,000	8.5	250	191	12
	"	10:00 A Oct. 7	2.6	13	4.73	44.6	3.4	2,300	7.8	130	265	45
	"	11:55 A Dec. 9	5	2	10.48	75.7	4.8	4,600	8.0	9	264	38
Big Creek	SH - 292.1 Bi.C.-42.6	12:40 P Aug. 4	32	20	5.72	62.5	4.0	9,300	7.6	1,000	90	1.5
Bridge - U. S. Highway #183 at Hays	"	8:45 A Aug. 23	23	22	5.80	65.7	4.6	4,300	8.6	230	192	8.0
	"	9:15 A Oct. 7	2	13	5.81	54.8	4.9	930	8.0	160	244	18
	"	11:00 A Dec. 9	2	1	12.19	85.6	3.6	460	7.9	15	236	20
Big Creek	SH - 292.1 Bi.C.-57.1	8:25 A Aug. 23	19	21	6.77	75.4	5.2	4,300	8.6	260	200	9.0
County bridge 3 miles east of Ellis	"	8:55 A Oct. 7	2	6	9.52	76.4	3.2	4,300	7.9	20	269	37
	"	10:30 A Dec. 9	2	0	12.26	83.8	2.2	930	8.0	15	214	18
Big Creek	SH - 292.1 Bi.C.-59.6	8:05 A Aug. 23	18	20	6.34	69.1	4.7	110,000	8.3	220	188	8.0
County bridge 1 mile east of Ellis	"	8:40 A Oct. 7	2	7	6.60	54.3	>6.6	>1,100,000	7.8	20	324	54
	"	10:20 A Dec. 9	2	0	11.73	80.2	3.7	43,000	7.9	25	214	15
Big Creek	SH - 292.1 Bi.C.-63.0	7:45 A Aug. 23	16	21	5.89	65.6	4.0	1,400	8.6	330	197	5.0
County Bridge, West side of Ellis	"	8:25 A Oct. 7	2	7	10.68	87.8	3.2	230	8.0	20	232	12
	"	10:00 A Dec. 9	2	0	11.75	80.4	1.2	460	7.9	25	211	8.6
Big Creek	SH - 292.1 Bi.C.-81.0	7:00 A Aug. 23	8	18	7.00	73.5	3.5	4,300	8.4	290	212	5.5
County bridge - 3 miles east and 4	"	7:45 A Oct. 7	1	6	10.74	86.2	3.3	730	8.0	45	212	7.0
miles south of Wakeeney												
Big Creek	SH - 292.1 Bi.C.-83.5	6:45 A Aug. 23	6	18	7.15	75.0	2.8	46,000	8.4	250	217	5.5
County bridge - 1½ mile east and 3	"	7:20 A Oct. 7	1	7	10.33	85.1	2.7	750	7.9	45	220	7.4
miles south of Wakeeney												

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Big Creek	SH - 292.1 Bi.C.-87.1	7:00 A Oct. 7	0.5	7	8.68	71.4	3.1	910	7.8	85	[illegible]	6.9
Bridge, U. S. Highway 283, 2 miles south of	"	7:45 A Dec. 9	1	0	10.97	75.0	0.9	230	7.7	25	206	5.4
WaKeeney												
Smoky Hill River	SH - 293.5	11:05 A Aug. 4	120	23	7.93	91.4	3.0	4,300	8.6	260	138	118
County bridge - 1.4 miles above con-	"	11:45 A Aug. 23	147	24	7.80	91.5	3.0	4,600	8.4	380	142	129
fluence with Big Creek	"	1:00 P Sept.21	20	30	8.34	109.2	0.8	91	8.2	10	172	599
	"	11:45 A Oct. 7	19	10	10.60	93.5	2.0	360	8.2	10	196	762
	"	1:40 P Dec. 9	20	5	12.98	101.3	4.1	36	8.0	15	181	394
Smoky Hill River	SH - 328.7	9:20 A Aug. 23	100	20	7.70	83.9	1.9	2,300	8.4	320	146	390
Bridge - U. S. Highway #183, 11 miles south	"	9:35 A Oct. 7	10	9	11.21	96.8	1.0	230	7.9	10	158	35
of Hays	"	11:30 A Dec. 9	10	1	12.72	89.4	1.8	9.1	7.9	15	172	31
Smoky Hill River	SH - 369.6	6:00 A Aug. 23	40	16	7.55	75.9	1.1	4,600	8.4	170	154	500
Bridge, U. S. Highway 283, 14 miles south	"	6:25 A Oct. 7	3	4	10.43	79.5	1.3	150	8.0	10	180	15
of WaKeeney	"	7:15 A Dec. 9	5	0	12.13	83.0	1.9	93	7.9	25	184	18

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Solomon River	S - 3.9	9:45 A Apr. 6	210	16	9.05	90.9	2.0	930	8.0	390	245	154
Bridge - Highway No. 40 - East of Solomon	"	3:00 P Apr. 21	150	18	9.36	98.3	3.6	91	8.4	220	280	237
	"	10:27 A Apr. 29	205	19	7.51	80.4	2.1	930	8.0	450	241	198
	"	10:15 A May 5	1,200	16	6.92	69.6	3.7	46,000	7.7	8,200	105	14
	"	11:37 A May 19	125	23	7.80	89.8	2.8	910	8.2	270	272	166
	"	11:55 A June 15	220	25	3.25	38.8	9.6	-	7.4	2,900	164	67
	"	1:55 P June 29	4,200	24	3.84	45.1	12.7	-	7.3	6,200	88	8.0
	"	11:45 A July 13	5,160	24	2.63	30.9	2.1	-	7.8	2,200	99	3.2
	"	3:10 P Aug. 3	570	24	5.74	67.3	1.6	9,300	7.8	700	240	135
	"	12:05 P Aug. 17	730	26	5.38	65.4	2.3	110,000	7.5	5,000	144	72
Solomon River	S - 16.9	10:10 A Apr. 6	198	16	9.07	91.2	2.0	930	8.0	380	253	140
Bridge - at Niles	"	3:25 P Apr. 21	147	18	9.44	99.0	4.7	230	8.4	150	296	214
	"	10:07A Apr. 29	220	19	7.57	81.0	2.7	430	8.0	360	257	180
	"	9:15 A May 5	1,480	16	7.63	76.7	4.7	7,500	7.6	6,000	128	11
	"	12:01 P May 19	115	23	8.10	93.3	3.9	930	8.2	230	281	141
	"	12:25 P June 15	314	26	3.68	44.7	9.8	-	7.8	3,400	160	65
	"	2:15 P June 29	4,400	24	2.67	31.3	10.5	-	7.3	7,400	96	10
	"	12:10 P July 13	3,300	24	3.09	36.2	2.2	-	7.6	2,400	100	13
	"	3:40 P Aug. 3	621	24	5.94	69.7	1.5	46,000	7.8	600	259	129
	"	12:35 P Aug. 17	691	26	6.00	72.9	2.7	46,000	7.5	3,500	144	49
Solomon River	S - 39.1	8:45 A Apr. 6	190	15	9.03	88.8	2.3	2,400	8.4	240	260	149
Highway No. 18 West of Bennington	"	2:00 P Apr. 21	160	17	9.14	93.8	4.4	930	8.4	120	301	229
	"	9:38 A Apr. 29	200	18	7.32	76.8	4.0	11,000	7.9	340	256	139
	"	11:10 A May 5	1,260	17	7.41	76.2	4.3	9,300	7.8	3,700	150	69
	"	12:47 P May 19	135	24	9.03	105.8	5.6	1,500	8.3	130	295	173
	"	10:50 A June 15	420	25	5.90	70.4	3.6	-	8.0	470	196	21
	"	2:55 P June 29	4,500	22	3.28	37.2	8.2	-	7.3	6,200	107	5.6
	"	12:50 P July 13	1,100	25	4.78	57.1	3.2	-	7.6	2,900	130	16
	"	4:15 P Aug. 3	620	24	6.10	71.5	1.7	24,000	7.7	650	260	159
	"	1:15 P Aug. 17	600	27	6.00	74.4	2.3	46,000	7.5	3,000	148	67
Solomon River	S - 44.1	8:30 A Apr. 6	185	15	9.02	88.8	2.1	2,400	8.2	190	258	135
Bridge 6 miles northeast of Bennington	"	4:00 P Apr. 21	165	18	9.08	95.2	4.8	2,400	8.3	150	296	228
	"	9:19 A Apr. 29	190	18	7.96	83.5	4.2	4,200	8.0	320	254	138
	"	9:10 A May 5	1,200	17	7.38	75.8	4.6	4,300	7.7	4,200	105	102
	"	1:00 P May 19	140	24	9.91	116.2	6.4	4,300	8.3	210	280	173
	"	10:35 A June 15	450	24	5.56	65.3	5.0	-	7.9	550	190	222
	"	3:15 P June 29	4,450	22	3.60	40.7	13.0	-	7.7	6,400	73	8.0
	"	1:05 P July 13	880	26	5.44	66.2	4.1	-	7.6	3,100	126	9.6
	"	4:50 P Aug. 3	600	24	6.39	74.9	2.0	12,000	8.0	700	262	152
	"	1:30 P Aug. 17	590	28	5.90	74.5	1.6	24,000	7.5	2,300	157	62

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Solomon River	S - 51.2	8:15 A Apr. 6	175	15	9.00	88.6	2.6	4,300	8.2	200	262	159
Bridge 2 miles south of Minneapolis	"	4:15 P Apr. 21	160	19	8.24	88.2	4.0	4,300	8.2	160	301	216
	"	9:04 A Apr. 29	180	18	7.98	83.7	3.6	7,500	8.0	240	238	112
	"	8:55 A May 5	1,240	17	8.13	83.4	3.8	9,300	7.6	2,600	122	63
	"	1:13 P May 19	130	26	10.96	123.8	7.0	910	8.2	100	253	165
	"	10:20 A June 15	1,200	20	1.97	21.5	10.7	-	7.6	2,400	104	449
	"	3:25 P June 29	4,350	23	3.66	42.2	11.8	-	7.7	6,000	89	4.0
	"	1:25 P July 13	840	27	5.59	68.1	3.3	-	7.8	2,600	132	15
	"	5:05 P Aug. 3	595	24	6.69	78.3	2.6	46,000	7.7	600	244	135
	"	1:50 P Aug. 17	570	28	5.90	74.5	1.7	46,000	7.5	2,000	163	52
Solomon River	S - 55.8	7:50 A Apr. 6	165	15	16.54	163.0	6.0	360	8.0	150	194	35
Bridge at Minneapolis.	"	4:30 P Apr. 21	140	19	8.73	93.4	7.2	430	8.2	120	277	180
	"	8:44 A Apr. 29	155	17	5.98	61.4	3.1	430	8.0	300	192	70
	"	8:40 A May 5	1,310	16	7.69	75.2	1.5	930	7.7	400	81	84
	"	1:30 P May 19	127	25	16.16	193.0	10.1	150	8.2	60	244	119
	"	9:35 A June 15	1,200	22	0.79	9.0	11.5	-	7.1	4,300	105	8.2
	"	3:40 P June 29	4,240	22	3.85	43.6	8.8	-	7.3	7,400	93	4.4
	"	1:40 P July 13	760	26	6.00	73.0	2.9	-	7.6	2,800	132	12
	"	5:30 P Aug. 3	575	24	6.69	78.3	1.9	15,000	7.7	550	232	115
	"	2:10 P Aug. 17	560	27	5.95	73.8	2.1	21,000	7.5	2,800	144	58
Solomon River	S - 84.5	7:15 A Apr. 6	138	16	9.70	97.6	3.2	750	8.0	150	268	151
Bridge 1 mile west of Delphos	"	5:00 P Apr. 21	118	18	8.92	93.5	5.6	930	8.2	50	293	224
	"	8:15 A Apr. 29	132	19	6.69	71.6	2.7	2,400	8.0	180	259	138
	"	8:00 A May 5	1,900	16	4.36	43.8	3.7	46,000	7.7	11,000	124	34
	"	2:08 P May 19	100	23	8.74	100.7	7.0	<360	8.2	85	281	204
	"	9:15 A June 15	1,350	21	1.82	20.2	10.7	-	7.3	2,600	126	74
	"	4:15 P June 29	3,800	22	3.51	39.8	9.6	-	7.5	5,600	115	5.8
	"	2:20 P July 13	580	26	5.00	60.8	3.2	-	7.6	3,000	156	40
	"	6:00 P Aug. 3	155	23	5.90	68.0	1.8	24,000	7.7	1,000	222	130
	"	2:45 P Aug. 17	1,250	27	3.55	43.9	2.5	46,000	7.6	8,600	152	40
Solomon River	S - 94.5	10:05 A Apr. 2	130	10	10.28	90.8	2.0	750	8.2	20	259	1,034
Bridge southwest of Glasco	"	8:45 A Apr. 13	110	12	9.60	88.6	5.4	2,400	8.2	85	264	206
	"	9:05 A Apr. 20	105	17	8.46	86.9	6.9	930	8.2	70	278	202
	"	9:50 A Apr. 26	160	17	7.36	75.6	2.9	2,400	7.9	250	193	86
	"	9:50 A May 6	300	14	7.31	70.5	4.2	75,000	7.6	8,000	95	11
	"	10:40 A May 14	95	20	7.96	86.8	3.0	9,300	8.0	220	231	130
	"	8:40 A June 4	650	21	4.60	51.3	2.8	-	7.7	8,000	156	6.2
	"	8:45 A June 14	120	23	6.65	76.7	3.8	-	8.4	330	225	102
	"	8:45 A June 28	750	22	4.92	55.8	3.8	-	7.5	7,600	89	3.8
	"	8:10 A July 12	485	24	4.35	51.0	2.7	-	7.6	3,700	135	18
	"	8:30 A July 26	800	24	5.51	64.7	2.8	>11,000	7.6	3,600	169	64
	"	8:35 A Aug. 19	500	25	4.92	58.9	3.7	46,000	7.5	8,400	120	22

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Solomon River Bridge southeast of Glasco	S - 94.5	8:35 A Aug. 31	105	25	5.92	70.7	4.3	2,300	8.1	160	333	14
	"	8:25 A Sept.17	85	21	6.53	72.7	2.2	240,000	7.9	200	344	341
	"	9:30 A Oct. 1	45	15	9.00	88.6	5.7	4,300	8.2	250	374	450
	"	11:00 A Oct. 6	46	15	8.57	84.5	6.1	2,400	8.0	320	363	432
	"	9:40 A Oct. 15	40	12	10.04	92.7	5.0	430	8.1	120	393	473
	"	8:30 A Nov. 29	50	0	12.09	82.6	2.1	430	8.4	15	379	380
	"	8:50 A Dec. 18	55	0	12.60	86.2	2.2	430	7.7	15	340	321
Solomon River												
No bridge - 2 miles east of Asherville	S - 117.0	10:40 A Apr. 2	115	11	10.59	95.7	3.0	24,000	8.2	130	228	50
	"	9:15 A Apr. 13	95	12	10.39	95.8	5.0	1,100	8.2	65	257	116
	"	9:40 A Apr. 20	85	17	9.03	92.8	5.7	4,300	8.2	60	262	123
	"	10:17 A Apr. 26	195	16	7.17	72.1	3.8	46,000	7.8	350	164	53
	"	10:30 A May 6	180	14	7.37	71.2	4.9	23,000	7.7	7,500	110	14
	"	11:10 A May 14	75	20	9.13	99.6	4.3	24,000	8.2	260	229	77
	"	9:05 A June 4	735	21	5.55	61.7	3.6	-	7.5	10,000	179	7.0
	"	9:15 A June 14	100	23	8.28	95.4	6.2	-	8.8	240	221	57
	"	9:15 A June 28	2,400	21	4.32	48.1	6.6	-	7.7	6,200	105	1.8
	"	8:35 A July 12	330	24	5.61	65.8	3.3	-	7.8	2,900	138	15
	"	9:00 A July 26	450	25	6.11	73.0	2.2	>11,000	7.7	2,000	118	49
	"	9:00 A Aug. 19	380	25	5.48	65.4	4.1	24,000	7.6	6,600	112	44
	"	9:00 A Aug. 31	85	25	6.38	76.2	4.6	9,300	8.3	210	298	7.7
	"	8:45 A Sept.17	60	20	7.69	83.8	5.8	46,000	7.9	150	265	188
	"	10:00 A Oct. 1	35	14	10.09	97.4	6.3	9,300	7.8	240	298	265
	"	11:40 A Oct. 6	36	14	9.99	96.4	7.0	46,000	8.1	170	341	265
	"	10:05 A Oct. 15	30	13	11.05	104.2	6.8	360	8.2	90	352	371
	"	8:55 A Nov. 29	40	0	12.20	83.4	2.6	4,300	8.4	15	351	353
	"	9:20 A Dec. 18	45	0	12.43	85.0	0.8	4,600	7.8	15	314	230
Solomon River County bridge 2 miles southeast of Beloit	S - 127.0	11:30 A Apr. 2	105	-	10.65	-	1.9	4,300	8.2	140	233	50
	"	9:55 A Apr. 13	87	14	9.75	94.1	3.7	<360	8.2	120	232	74
	"	10:10 A Apr. 20	75	17	7.43	76.3	6.8	7,500	8.2	140	247	81
	"	10:35 A Apr. 26	150	17	7.25	74.4	3.3	46,000	7.9	400	221	57
	"	10:50 A May 6	160	16	7.81	78.6	2.3	9,100	7.7	2,400	110	16
	"	11:30 A May 14	65	19	9.83	105.2	3.8	15,000	8.2	210	232	65
	"	9:25 A June 4	660	23	5.71	65.8	3.6	-	7.5	9,200	143	3.9
	"	9:40 A June 14	85	24	6.72	78.7	4.4	-	8.2	240	214	88
	"	9:25 A June 28	2,850	21	3.42	38.1	8.6	-	7.5	6,600	65	5.0
	"	9:00 A July 12	290	26	5.66	68.8	3.3	-	7.8	1,100	154	16
	"	9:30 A July 26	300	25	6.09	72.7	1.8	46,000	7.7	1,400	168	42
	"	9:30 A Aug. 19	330	26	5.55	67.5	2.8	24,000	7.5	5,200	108	36
	"	9:20 A Aug. 31	75	26	6.00	73.1	4.9	46,000	8.3	160	280	6.3
	"	9:10 A Sept.17	48	22	5.16	58.4	4.7	110,000	7.9	200	302	163
	"	10:15 A Oct. 1	31	15	7.32	72.2	4.7	110,000	8.0	160	330	220
	"	10:30 A Oct. 15	27	13	8.43	79.5	6.4	>11,000	7.9	65	316	194
	"	9:20 A Nov. 29	32	0	10.39	71.0	3.6	46,000	8.1	20	338	[illegible]
	"	9:45 A Dec. 18	42	0	10.86	74.3	3.3	110,000	7.7	15	298	160

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Solomon River Intake, Water Plant at Beloit	S - 130.7	11:45 A Apr. 2	100	-	10.18	-	1.9	93	8.2	100	233	45
	"	9:45 A Apr. 13	82	14	9.64	93.0	4.3	93	8.2	95	236	73
	"	10:30 A Apr. 20	73	19	8.00	85.6	2.8	460	8.2	110	244	74
	"	10:53 A Apr. 26	147	18	7.03	73.8	2.5	430	7.9	250	220	43
	"	11:05 A May 6	160	16	7.40	74.4	-	750	7.9	700	120	18
	"	12:00 N May 14	63	20	10.34	113.0	3.0	11,000	8.3	180	236	61
	"	9:45 A June 4	595	23	5.36	61.7	3.6	-	7.7	7,500	118	5.3
	"	9:55 A June 14	75	25	6.72	80.2	3.2	-	8.0	180	209	5.2
	"	10:10 A June 28	2,970	22	4.20	47.6	3.8	-	7.7	6,000	62	4.4
	"	9:15 A July 12	280	25	5.25	62.7	2.5	-	7.8	1,000	156	14
	"	9:45 A July 26	255	25	5.53	66.1	0.9	11,000	7.8	1,000	122	35
	"	9:45 A Aug. 19	320	26	5.53	67.3	1.6	29,000	7.6	3,200	104	26
	"	9:40 A Aug. 31	71	27	6.75	83.6	4.3	910	8.3	170	271	5.6
	"	9:30 A Sept. 17	46	22	7.65	86.7	2.5	360	8.0	180	281	139
	"	10:30 A Oct. 1	30	16	10.41	104.8	4.2	230	7.9	150	328	191
	"	12:00 N Oct. 6	31	15	8.31	81.8	2.1	210	8.1	240	328	204
	"	10:45 A Oct. 15	25	13	12.09	114.0	4.5	150	7.9	95	315	167
	"	9:40 A Nov. 29	35	1	11.92	83.8	1.7	210	8.4	20	339	189
	"	10:00 A Dec. 18	40	0	13.30	90.9	1.1	430	7.9	15	302	134
Solomon River At Glen Elder Dam Site	S - 156.1	12:20 P Apr. 2	87	-	10.67	-	1.8	<360	8.2	140	236	38
	"	10:30 A Apr. 13	67	12	10.47	96.6	2.9	150	8.2	35	226	45
	"	11:00 A Apr. 20	58	17	9.35	96.1	5.1	240	8.3	40	233	51
	"	11:28 A Apr. 26	70	16	7.96	80.0	4.3	>11,000	7.9	2,400	187	38
	"	11:35 A May 6	160	16	8.47	85.2	2.8	4,300	7.9	2,000	154	19
	"	12:28 P May 14	49	22	9.80	111.0	4.6	2,000	8.2	350	248	53
	"	10:15 A June 4	450	22	6.23	70.6	3.2	-	7.6	6,800	129	6.5
	"	10:35 A June 14	65	24	8.11	95.3	5.5	-	8.2	340	204	43
	"	10:40 A June 28	3,150	23	4.62	53.3	6.9	-	7.5	11,000	144	5.4
	"	10:00 A July 12	480	26	4.86	59.1	3.6	-	7.8	14,000	151	5.2
	"	10:25 A July 26	200	26	6.56	79.8	2.4	>11,000	7.8	1,600	162	13
	"	10:30 A Aug. 19	245	26	6.22	75.6	3.0	46,000	7.7	3,500	110	26
	"	10:15 A Aug. 31	50	26	7.37	89.7	5.0	1,400	8.3	180	254	3.5
	"	10:00 A Sept. 17	25	22	7.79	88.3	3.3	910	8.1	200	260	109
	"	11:05 A Oct. 1	23	16	9.40	94.5	2.4	230	7.9	110	282	137
	"	12:35 P Oct. 6	24	14	9.91	95.5	5.3	460	8.0	90	289	158
	"	11:10 A Oct. 15	18	14	10.89	105.0	1.8	230	8.2	15	278	136
	"	10:40 A Nov. 29	28	0	13.06	89.3	2.0	150	8.4	10	288	27
	"	10:25 A Dec. 18	37	0	12.85	87.8	0.9	230	7.9	10	268	81
Solomon River Bridge at Cawker City	S - 171.1	12:45 P Apr. 2	78	-	11.18	-	1.8	9,300	8.2	120	233	19
	"	11:00 A Apr. 13	57	12	11.20	103.3	2.2	2,300	8.2	25	228	21
	"	11:30 A Apr. 20	47	17	10.64	109.3	4.5	1,500	8.3	30	231	21
	"	11:55 A Apr. 26	51	19	9.82	105.0	4.6	2,400	8.2	390	218	24
	"	12:10 P May 6	230	16	8.33	83.8	3.7	15,000	7.9	2,000	192	24

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
Solomon River Bridge at Cawker City	S - 171.1	12:53 P May 14	40	22	9.87	111.8	5.4	4,300	8.3	280	240	14
	"	10:40 A June 4	390	23	6.59	76.1	3.3	-	7.8	5,800	138	2.9
	"	10:55 A June 14	55	24	8.06	94.6	4.4	-	8.2	290	237	9.2
	"	11:05 A June 28	2,400	21	4.25	47.4	10.4	-	7.5	9,400	83	3.8
	"	10:25 A July 12	390	25	5.73	68.4	4.5	-	7.8	10,000	131	6.4
	"	10:55 A July 26	145	26	6.83	83.1	2.2	24,000	7.8	1,000	124	10
	"	10:55 A Aug. 19	195	26	6.62	80.5	2.4	110,000	7.8	3,800	109	21
	"	10:40 A Aug. 31	35	27	8.17	101.0	5.3	2,300	8.3	210	225	15
	"	10:25 A Sept.17	11	21	7.96	88.5	4.1	2,300	7.9	110	241	21
	"	11:30 A Oct. 1	11	15	10.31	101.5	3.2	930	7.9	30	232	24
	"	1:05 P Oct. 6	12	14	9.43	91.0	4.8	2,400	8.0	45	249	25
	"	11:35 A Oct. 15	7	13	13.76	129.8	2.2	230	8.3	10	246	26
	"	11:05 A Nov. 29	16	0	13.53	92.6	2.4	4,600	8.2	15	300	92
	"	10:50 A Dec. 18	33	0	12.86	87.8	1.3	24,000	7.9	9	263	26
North Fork Solomon River Bridge - U. S. Highway 24, 3 miles west of Downs	S - 171.6 NFS - 16.4	1:20 P May 14	21	24	10.13	119.0	3.7	93	8.3	20	240	9.0
	"	11:30 A June 4	135	24	6.94	81.4	3.5	-	7.6	4,100	141	0.3
	"	11:30 A June 14	24	25	7.98	95.3	4.4	-	8.4	180	201	9.2
	"	11:35 A June 28	2,920	21	4.56	50.7	4.1	-	7.4	13,000	91	1.6
	"	10:55 A July 12	314	25	6.49	77.4	3.6	-	7.7	17,000	107	0.8
	"	11:30 A July 26	46	27	7.45	92.3	3.0	11,000	8.0	1,200	134	2.2
	"	11:25 A Aug. 19	38	27	6.65	80.9	1.9	24,000	7.8	2,600	114	2.0
	"	11:10 A Aug. 31	8	26	7.40	90.0	4.4	3,900	8.2	25	200	6.0
	"	10:55 A Sept.17	3	22	8.62	97.8	2.7	930	8.1	50	260	8.3
	"	11:55 A Oct. 1	3	16	12.13	122.0	2.9	930	8.1	30	260	14
	"	1:35 P Oct. 6	3	13	10.21	96.4	4.3	11,000	8.0	25	261	16
	"	12:00 N Oct. 15	2.6	15	12.17	119.8	7.7	230	8.3	75	259	12
	"	11:30 A Nov. 29	9	0	12.77	87.2	3.0	430	8.3	60	314	13
	"	11:05 A Dec. 18	16	0	12.68	86.6	1.1	<30	7.9	10	281	14
North Fork Solomon River Bridge at Portis U. S. Highway #281	S - 171.6 NFS - 25.6	1:20 P Apr. 2	37	-	11.23	-	1.6	<360	8.2	80	233	9.6
	"	11:40 A Apr. 13	34	13	11.41	107.7	2.4	43	8.2	20	230	11
	"	12:15 P Apr. 20	30	17	9.96	102.2	2.6	150	8.3	15	236	11
	"	12:30 P Apr. 26	33	19	9.59	102.5	2.1	240	8.3	20	244	17
	"	12:55 P May 6	59	17	9.61	98.7	7.4	240	8.1	130	211	10
	"	1:40 P May 14	21	23	11.40	131.6	2.8	240	8.3	25	233	9.6
	"	11:10 A June 4	130	22	6.85	77.7	3.1	-	7.5	4,400	139	0.6
	"	11:55 A June 14	24	25	7.88	94.1	3.8	-	8.0	180	193	6.4
	"	12:20 P June 28	2,160	21	3.46	38.5	9.4	-	7.4	29,000	109	2.4
	"	11:40 A July 12	145	25	6.55	78.2	2.9	-	7.8	11,000	108	2.5
	"	12:15 P July 16	44	28	6.51	82.3	1.6	2,400	8.0	800	138	2.6
	"	7:10 A Aug. 4	14	18	7.25	76.1	4.9	3,600	8.4	180	206	5.1
	"	11:50 A Aug. 19	36	26	7.10	86.4	1.7	4,300	7.9	1,300	122	15
	"	11:40 A Aug. 31	7	27	8.19	101.0	5.0	9,300	8.3	550	194	5.8
	"	11:20 A Sept.17	3	23	7.84	90.3	3.1	430	8.0	160	236	14

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
North Fork Solomon	S - 171.6 NFS - 25.6	3:25 P Sept. 21	25	26	9.23	116.5	7.0	4,600	7.9	130	244	13
River Bridge at Portis	"	12:13 P Oct. 1	2.5	18	9.16	96.2	4.0	930	7.8	170	233	15
U.S. Highway #281	"	2:00 P Oct. 6	2.5	13	8.76	82.6	3.8	930	7.9	95	241	15
	"	12:35 P Oct. 15	2	16	10.32	102.9	1.6	2,400	7.9	30	226	14
	"	4:25 P Oct. 19	1.5	11	10.55	99.6	4.7	430	7.9	15	246	15
	"	1:35 P Nov. 2	5	-	8.21	-	4.7	430	8.0	35	278	13
	"	11:50 A Nov. 29	8	1	12.70	89.3	2.9	91	8.3	15	294	14
	"	1:25 P Dec. 8	8	3	13.54	100.5	1.6	36	7.9	15	258	14
	"	11:20 A Dec. 16	8	0	13.21	90.3	1.4	230	7.9	15	248	14
North Fork Solomon	S - 171.6 NFS - 42.9	9:40 A May 11	16	11	10.04	90.8	1.0	430	8.3	55	237	8.8
River State Highway	"	7:25 A May 20	12	18	7.43	77.8	1.9	930	8.2	55	244	8.2
County Bridge - 1 mile south of	"	2:10 P June 2	700	23	6.74	77.7	4.1	-	7.7	8,500	131	2.9
Gaylord	"	1:50 P June 9	31	28	7.70	97.3	4.1	-	8.4	280	188	5.8
	"	2:45 P June 17	41	27	6.54	80.8	0.7	-	7.8	1,900	147	4.8
	"	1:50 P June 23	1,000	22	5.27	59.7	4.7	-	7.6	9,600	118	3.0
	"	12:55 A June 28	1,050	22	5.01	56.8	4.4	-	7.6	17,000	95	2.0
	"	2:30 P June 30	190	27	6.81	84.4	4.5	-	7.7	7,000	102	2.1
	"	2:20 P July 8	28	19	7.51	80.3	3.5	-	8.5	250	198	6.5
	"	12:15 P July 12	100	25	7.04	84.0	3.7	-	7.8	8,000	112	1.1
	"	1:35 P July 14	40	27	6.94	85.9	1.9	-	8.2	1,000	141	2.1
	"	3:40 P July 21	520	23	5.93	68.3	4.9	-	7.6	17,000	101	0.9
	"	12:40 P July 26	35	28	7.13	89.9	1.7	24,000	8.2	550	148	2.9
	"	6:30 P July 28	33	25	3.63	43.3	11.4	1,100,000	7.5	11,000	97	6.3
	"	3:00 P Aug. 10	60	31	7.17	95.6	3.6	9,100	8.4	360	181	5.0
	"	12:15 P Aug. 19	24	27	6.95	86.2	1.6	9,300	8.0	1,100	137	6.0
	"	3:15 P Aug. 24	6	30	7.35	96.3	5.0	9,100	8.1	130	220	6.7
	"	12:15 P Aug. 31	6	28	7.81	98.8	3.9	2,300	8.3	200	208	5.0
	"	2:10 P Sept. 2	4	31	10.56	141.0	4.9	46,000	8.6	35	236	7.8
	"	11:45 A Sept. 17	2	24	9.38	110.0	7.0	2,400	8.2	280	252	12
	"	2:35 P Sept. 29	1.6	22	15.73	178.2	3.4	910	8.6	15	242	10
	"	2:30 P Oct. 6	1.6	13	10.41	98.4	5.5	4,600	8.1	30	310	12
	"	3:15 P Oct. 12	1.4	14	13.70	132.2	3.3	930	8.3	20	269	12
	"	12:55 P Oct. 15	1.4	17	12.47	128.0	6.0	1,500	8.1	45	355	10
	"	12:10 P Nov. 29	7	1	12.25	86.1	3.8	4,300	8.0	30	306	14
	"	2:50 P Dec. 2	7	1	12.83	90.2	2.6	11,000	8.2	15	258	11
	"	1:50 P Dec. 10	7	1	12.49	87.6	1.8	4,600	7.8	25	302	13
	"	11:05 A Dec. 16	10	4	13.04	99.3	3.7	11,000	7.9	15	280	12
Beaver Creek	S - 171.6 NFS - 44.9	12:30 P Aug. 19	5	25	5.80	69.3	3.1	46,000	7.8	280	124	11
Bridge - West end of Gaylord	Be.C.-0.1 "	12:25 P Aug. 31	1	25	6.10	72.9	>6.1	9,300	8.3	200	144	4.1
	"	12:25 P Nov. 29	1	1	4.85	34.1	21.7	2,400	8.1	20	368	30
	"	11:15 A Dec. 16	0.5	3	4.91	36.4	9.5	230	7.5	15	384	36
Cedar Creek	S - 171.6 NFS - 47.7	1:45 P Aug. 19	-	31	11.68	156.0	7.8	15,000	8.1	250	218	45
State Highway #9, 9½ Mi. E of Kerwin	Ced.C.-1.0	12:40 P Aug. 31	-	28	4.72	59.7	5.6	46,000	7.5	200	139	6.1

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Cedar Creek	S - 171.6 NFS - 47.7	12:15 P Sept. 17	-	25	8.72	104.0	7.0	4,300	8.4	160	246	25
State Highway #9 7½ mi. E. of Kirwin	Ced.C.-1.0											
Deer Creek	S - 171.6 NFS - 65.1	4:00 P Aug. 11	1	22	5.92	67.1	4.8	240,000	7.6	22,500	100	1.0
Bridge - State Highway #9, 1/2 mile east	D.C. - 0.3 "	12:50 P Nov. 29	1	3	0.00	00.0	44.9	2,400	7.5	100	412	7.9
of Kirwin	"	11:45 A Dec. 18	0.5	1	0.00	00.0	>69.6	36	7.1	190	439	11
North Fork Solomon	S - 171.6 NFS - 66.5	10:15 A May 11	12	12	9.97	91.8	2.6	930	8.2	220	288	7.4
County bridge - south of Kirwin	"	8:00 A May 20	7	17	8.19	84.2	1.4	2,400	8.1	35	252	8.1
	"	3:50 P Aug. 11	6	22	7.35	83.2	3.1	4,300	8.5	140	192	5.6
	"	1:10 P Aug. 19	12	27	7.32	90.7	1.9	2,300	8.2	500	154	13
	"	1:10 P Aug. 31	4	28	8.28	104.0	2.8	4,600	8.3	210	228	7.6
	"	12:45 P Sept. 17	0.2	25	7.97	95.2	3.4	930	8.4	35	258	8.8
	"	3:05 P Oct. 6	0.2	13	8.11	76.5	5.0	4,600	7.9	25	285	7.9
	"	1:50 P Oct. 15	0.3	16	9.52	95.7	6.8	750	8.0	15	250	7.3
	"	1:05 P Nov. 29	4.5	4	11.75	89.7	3.8	930	8.0	20	280	9.7
	"	2:10 P Dec. 2	4.4	1	12.15	85.4	2.1	230	8.1	10	250	7.9
	"	12:10 P Dec. 18	4.5	1	12.34	86.7	4.1	91	7.9	55	269	11
North Fork Solomon	S - 171.6 NFS - 80.1	10:40 A May 11	10	11	11.22	111.5	1.2	430	8.2	160	224	7.3
Bridge south of Glade	"	8:25 A May 20	4	20	8.38	91.4	1.6	930	8.3	180	241	7.6
North Fork Solomon	S - 171.6 NFS - 105.3	11:14 A May 11	4	15	10.18	100.2	1.3	280	8.3	15	266	7.4
County bridge - 1½ miles west of	"	9:00 A May 20	2	21	8.53	94.8	0.9	430	8.2	25	266	8.1
Logan												
North Fork Solomon	S - 171.6 NFS - 125.0	12:00 N May 11	2	14	10.72	103.3	1.1	290	8.2	15	244	7.2
U.S. Highway East of Clydesdale	"	9:45 A May 20	1	17	7.48	76.8	3.0	1,500	8.0	40	292	8.1
	"	10:30 A June 2	60	20	6.88	75.2	2.9	-	7.9	2,100	162	1.4
	"	10:20 A June 9	5	22	6.87	77.8	3.6	-	7.9	1,400	142	1.9
	"	10:30 A June 17	8	20	6.62	72.2	3.7	-	7.8	3,600	76	2.3
	"	10:15 A June 23	180	19	7.34	78.5	3.1	-	7.8	1,600	122	1.3
	"	10:55 A June 30	160	23	7.09	81.6	4.8	-	7.9	5,600	132	1.3
	"	10:40 A July 8	6	26	9.66	117.8	2.4	-	8.7	20	264	9.4
	"	9:55 A July 14	8	24	7.65	89.7	1.9	-	8.3	85	296	7.7
	"	11:30 A July 21	100	22	6.71	76.1	3.9	-	7.8	4,000	115	1.8
	"	2:35 P July 28	10	32	7.19	97.2	3.6	4,300	8.6	85	232	6.6
	"	10:50 A Aug. 10	10	21	6.95	77.5	2.3	24,000	8.3	250	224	6.7
	"	11:25 A Aug. 24	2	25	9.85	117.3	2.0	15,000	8.5	15	204	6.0
	"	10:40 A Sept. 2	1	25	7.98	95.3	2.5	9,300	8.1	25	268	6.6
	"	10:40 A Sept. 29	0.1	14	9.84	94.9	2.0	4,600	8.1	15	280	7.6
	"	11:05 A Oct. 12	0.2	8	10.16	85.6	2.3	390	7.9	15	276	7.5
	"	10:15 A Dec. 10	0.2	0	11.52	78.8	0.5	91	7.8	60	280	8.7
North Fork Solomon	S - 171.6 NFS - 149.0	10:25 A May 20	0.5	17	7.60	81.3	5.2	2,400	8.1	25	296	10
State Highway south of Allison												

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
South Fork Solomon	S - 171.6 SFS - 26.1	3:15 P May 20	8	25	7.63	91.2	>7.6	>110,000	7.5	180	216	23
Bridge - U.S. High-way #281 at Osborne	"	1:25 P June 2	220	21	6.85	76.3	3.9	-	7.8	6,100	124	4.4
	"	1:10 P June 9	27	26	7.48	91.1	4.3	-	8.3	400	183	20
	"	2:05 P June 17	465	25	4.94	58.9	2.0	-	7.6	14,000	116	8.5
	"	1:10 P June 23	1,600	21	4.32	48.1	3.6	-	7.6	7,800	108	3.0
	"	12:00 M June 28	1,700	21	5.73	64.0	>5.7	-	7.5	11,000	87	6.2
	"	1:50 P June 30	570	25	6.56	78.3	3.9	-	7.7	6,000	102	3.7
	"	1:35 P July 8	102	22	7.65	86.6	2.9	-	8.3	240	192	18
	"	11:20 A July 12	94	25	6.96	83.1	3.5	-	8.1	360	156	17
	"	12:50 P July 14	71	27	7.07	87.6	3.4	-	8.2	280	186	18
	"	2:55 P July 21	384	25	6.60	78.8	5.9	-	7.9	5,700	104	5.3
	"	12:55 P July 26	68	27	7.10	88.0	3.9	>110,000	8.1	350	168	19
	"	5:40 P July 28	52	29	7.28	93.6	6.3	460,000	8.3	220	212	24
	"	7:30 A Aug. 4	700	17	3.81	39.2	>3.8	460,000	7.7	16,500	126	10
	"	2:15 P Aug. 10	61	27	7.36	91.3	3.1	240,000	8.3	350	176	17
	"	2:30 P Aug. 24	43	28	7.80	98.5	4.4	93,000	8.3	200	188	17
	"	1:30 P Sept. 2	18	28	7.95	100.0	6.5	>110,000	8.3	100	218	23
	"	3:00 P Sept. 21	7	26	7.53	91.6	>7.5	460,000	7.8	120	237	26
	"	1:55 P Sept.29	6	18	10.14	106.5	>10.1	2,400,000	7.9	100	225	22
	"	2:40 P Oct. 12	4	13	10.22	96.5	>10.2	1,100,000	7.9	95	249	24
	"	4:05 P Oct. 19	5	12	9.59	88.4	8.8	1,100,000	7.8	90	246	27
	"	1:15 P Nov. 2	10	-	7.51	-	8.8	930,000	7.9	70	281	27
	"	1:05 P Dec. 8	12	3	12.91	96.0	3.8	460,000	7.9	100	231	28
	"	1:10 P Dec. 10	6	1	13.20	92.7	6.3	2,400,000	7.9	50	238	29
South Fork Solomon	S - 171.6 SFS - 47.6	2:30 P May 11	10	12	9.79	90.4	1.7	430	8.3	110	300	20
County bridge south of Alton	"	2:45 P May 20	4	26	9.92	128.0	6.2	430	8.2	180	220	23
	"	12:55 P June 2	180	23	7.00	80.7	3.4	-	7.9	4,200	155	6.6
	"	12:35 P June 9	34	24	7.54	88.4	3.0	-	8.0	170	180	20
	"	1:30 P June 17	318	25	6.06	72.3	1.0	-	7.7	11,000	102	4.9
	"	12:35 P June 23	1,290	22	6.20	70.3	4.0	-	7.6	7,400	104	3.8
	"	1:10 P June 30	470	26	6.90	83.9	4.3	-	7.7	4,700	108	4.1
	"	12:55 P July 8	105	26	7.21	88.9	2.5	-	8.2	220	186	21
	"	12:15 P July 14	66	26	7.78	94.7	2.2	-	8.5	180	195	20
	"	2:20 P July 21	238	25	6.40	76.4	3.7	-	7.9	7,400	108	4.8
	"	5:05 P July 28	42	30	8.10	106.1	6.1	1,500	8.7	180	193	26
	"	1:35 P Aug. 10	49	27	7.80	96.6	2.1	1,500	8.4	330	176	21
	"	1:50 P Aug. 24	130	25	8.34	99.4	2.6	4,600	8.3	130	184	18
	"	1:50 P Sept. 2	13	28	7.69	97.0	2.8	4,300	8.4	100	210	19
	"	1:10 P Sept.29	3.1	19	11.11	118.9	1.9	150	8.2	40	212	19
	"	2:10 P Oct. 12	3.1	13	11.33	106.8	1.8	36	8.0	25	221	21
	"	1:40 P Dec. 10	4.9	1	14.31	100.5	1.2	43	7.9	15	232	29
	"	2:20 P Dec. 13	15	6	12.99	104.1	1.1	43	7.9	10	220	32

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
South Fork Solomon	S - 171.6 SFS - 71.2	12:45 P Aug. 20	41	23	7.40	87.6	2.0	4,300	8.3	510	167	14
No bridge - access county road - 3 miles	"	1:55 P Aug. 30	23	33	7.58	103.9	5.1	2,300	8.7	60	192	24
east of Stockton												
South Fork Solomon	S - 171.6 SFS - 74.0	2:50 P Aug. 12	45	30	6.96	91.1	2.4	2,300	8.6	180	188	26
County bridge 1 mile east of Stockton	"	12:25 P Aug. 20	60	23	7.52	86.7	1.6	1,500	8.5	270	168	13
	"	1:40 P Aug. 30	22	32	8.40	113.6	4.2	930	8.7	60	134	23
	"	1:55 P Oct. 20	1	12	10.44	96.4	4.3	930	7.9	4	214	33
	"	1:25 P Dec. 13	16	6	13.02	104.4	1.3	460	8.0	50	188	30
South Fork Solomon	S - 171.6 SFS - 76.0	1:47 P May 11	6	14	9.83	94.8	1.0	930	8.2	25	220	27
Bridge - U. S. Highway #183 - South of	"	2:10 P May 20	3	27	16.90	204.8	4.6	930	8.3	20	212	22
Stockton	"	12:10 P June 2	130	24	7.31	85.7	2.0	-	8.0	1,400	147	7.6
	"	11:55 A June 9	60	26	6.92	84.3	2.9	-	8.0	4,500	123	6.8
	"	12:55 P June 17	250	24	6.80	79.8	5.4	-	7.8	13,000	99	4.4
	"	11:50 A June 23	730	21	7.08	78.8	4.6	-	7.6	4,200	100	4.8
	"	12:30 P June 30	620	22	6.98	79.1	3.0	-	7.9	2,200	122	8.4
	"	12:15 P July 8	95	27	7.14	88.4	1.6	-	8.5	160	192	24
	"	11:35 A July 14	65	27	6.89	85.3	1.7	-	8.5	150	195	27
	"	1:25 P July 21	230	23	6.91	79.6	3.5	-	8.0	3,300	121	10
	"	4:20 P July 28	20	33	6.01	82.3	2.9	2,300	8.7	110	191	34
	"	2:45 P Aug. 4	660	23	6.69	77.2	>6.7	110,000	7.6	5,000	94	4.3
	"	12:35 P Aug 10	28	28	6.84	86.3	2.5	4,600	8.6	260	186	25
	"	2:30 P Aug. 11	25	30	6.59	86.3	2.2	2,300	8.6	170	187	26
	"	12:00 N Aug. 20	40	23	7.48	86.2	1.7	4,600	8.6	270	164	15
	"	1:10 P Aug. 24	22	28	7.03	88.7	1.0	11,000	8.3	45	200	27
	"	1:25 P Aug. 30	11	31	7.13	95.1	3.9	4,300	8.7	85	194	26
	"	12:15 P Sept. 2	4	27	7.31	90.6	4.8	9,300	8.2	40	213	31
	"	3:10 P Sept.16	2	22	13.08	148.0	3.0	4,600	8.3	20	224	27
	"	12:05 P Sept.29	1.5	14	13.24	127.8	3.2	910	7.8	15	246	26
	"	1:10 P Oct. 12	1	8	13.32	112.4	1.7	930	7.9	100	284	5.6
	"	1:35 P Oct. 20	0.9	10	13.30	117.2	3.8	930	7.8	10	250	25
	"	11:55 A Dec. 10	11	1	11.68	82.0	0.8	460	7.8	25	232	33
	"	1:10 P Dec. 13	17	6	12.44	99.8	5.2	460	8.0	140	186	32
	"	3:00 P Dec. 15	12	3	12.95	96.1	3.2	4,600	8.3	150	190	25
South Fork Solomon	S - 171.6 SFS - 91.4	2:00 P Aug. 11	14	31	6.22	82.9	2.0	360	8.6	100	190	24
County bridge at Webster	"	11:35 A Aug. 20	30	23	7.88	90.8	1.6	910	8.5	210	174	15
	"	12:55 P Aug. 30	0.1	23	1.61	20.4	3.7	11,000	7.5	55	200	21
	"	2:50 P Sept.16	0.1	23	9.98	115.0	3.0	2,400	8.4	15	168	19
	"	12:45 P Oct.12	0.1	11	15.02	135.8	4.0	430	8.0	25	180	16
	"	1:05 P Oct. 20	0.2	11	13.07	118.0	2.6	230	8.0	8	185	16
	"	12:40 P Dec. 13	19	6	12.38	99.2	1.8	230	7.9	190	193	22
South Fork Solomon	S - 171.6 SFS - 110.0	1:00 P May 11	4	15	9.43	92.9	0.9	91	8.2	30	208	7.9
State Highway #18 North of Bogue												

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
South Fork Solomon	S - 171.6 SFS - 116.0	1:20 P Aug. 11	9	29	6.53	84.0	1.4	910	8.5	100	214	11
County bridge 3 miles east of Hill City	"	10:50 A Aug. 20	20	22	7.60	86.2	1.1	750	8.4	150	202	9.0
	"	12:05 P Aug. 30	01	31	7.18	95.7	2.3	910	8.4	65	204	11
	"	2:00 P Sept. 16	01	24	8.34	97.7	-	11,000	8.4	25	127	15
	"	11:50 A Oct. 12	0.1	17	12.10	124.2	2.0	1,500	8.0	10	190	15
	"	12:20 P Oct. 20	0.1	9	8.32	71.8	7.9	4,600	7.7	<1	180	12
	"	11:40 A Dec. 13	25	5	12.69	99.1	2.8	460	7.9	260	214	11
	"	2:07 P Dec. 15	19	4	12.55	95.6	1.0	240	8.2	150	232	11
South Fork Solomon	S - 171.6 SFS - 119.0	12:36 P May 11	4	25	9.40	92.7	0.9	110	8.2	35	251	8.4
Bridge - U.S. Highway #283 at Hill City	"	12:15 P May 20	0.1	29	6.94	89.3	0.7	230	8.3	20	216	9.9
	"	11:05 A June 2	70	24	7.33	86.0	1.0	-	8.4	210	231	8.2
	"	10:50 A June 9	30	28	6.94	87.7	1.3	-	8.3	270	202	11
	"	11:05 A June 17	120	24	6.55	76.7	1.8	-	7.9	1,800	131	5.6
	"	10:50 A June 23	300	22	7.37	83.4	0.9	-	8.4	320	180	6.2
	"	11:20 A June 30	400	26	6.94	84.4	1.8	-	8.3	700	175	7.3
	"	11:15 A July 8	80	29	6.52	83.9	1.5	-	8.5	130	209	9.9
	"	10:3 A July 14	60	25	7.05	84.1	1.0	-	8.4	95	222	9.2
	"	12:10 P July 21	90	23	7.28	83.9	3.0	-	8.7	1,050	201	8.4
	"	3:15 P July 28	10	35	6.32	89.1	2.4	360	8.7	60	216	12
	"	11:40 A Aug. 10	10	22	6.67	75.5	1.2	2,400	8.3	90	215	11
	"	12:50 P Aug. 11	9	29	6.39	82.2	1.6	4,300	8.5	120	209	11
	"	10:30 A Aug. 20	15	22	7.60	86.2	1.2	2,400	8.4	140	212	9.8
	"	12:05 P Aug. 24	4	28	6.85	86.5	0.6	1,500	8.4	35	219	11
	"	11:45 A Aug. 30	0.1	31	6.60	88.0	1.4	2,300	8.5	60	218	13
	"	11:15 A Sept. 2	0.1	29	6.82	87.8	1.0	4,600	8.3	25	224	9.6
	"	1:25 P Sept.16	0.1	23	8.05	92.8	4.4	24,000	8.4	20	207	11
	"	11:10 A Sept.29	0.1	23	8.89	102.4	1.3	910	8.2	8	213	10
	"	11:40 A Oct. 12	0.1	17	9.25	95.0	2.8	91	7.9	15	201	8.5
	"	12:05 P Oct. 20	0.1	9	9.06	78.2	3.6	11,000	8.0	10	217	11
	"	11:00 A Dec. 10	15	4	12.17	92.6	1.1	240	8.0	25	257	12
	"	11:15 A Dec. 13	25	4	12.64	96.3	2.4	1,100	8.1	200	217	10
	"	2:07 P Dec. 15	17	4	12.78	97.2	1.8	150	8.3	140	243	12
South Fork Solomon	S - 171.6 SFS - 142.5	11:45 A May 20	2	21	11.78	131.0	2.8	4,300	8.3	40	236	7.8
Highway southwest of Tasco	"	9:50 A Aug. 20	10	20	7.15	78.0	2.8	2,300	8.3	200	227	10
	"	11:00 A Aug. 30	0.1	25	9.02	107.7	2.4	2,300	8.5	45	227	11
	"	11:15 A Oct.20	.05	11	8.74	78.9	2.8	430	7.9	60	251	7.4
	"	10:25 A Dec. 13	20	3	11.76	87.4	2.1	240	7.9	30	259	12
Sand Creek	S - 171.6 SFS - 150.0	9:30 A Aug. 20	0	20	7.15	78.0	5.6	2,300	8.2	100	237	11
Bridge - U. S. Highway #24 - east of Hoxie	Sd.C.-7.0 "	10:20 A Aug. 30	0	23	5.78	66.7	5.0	2,400	7.8	85	263	11
	"	11:00 A Oct. 20	.05	9	9.72	84.0	9.3	91	7.9	50	228	8.9
Sand Creek	S - 171.6 SFS - 150.0	10:00 A Dec. 13	5	2	7.28	52.6	1.3	43	7.7	40	260	13
County bridge - 1/2 mile east of Hoxie	Sd.C.- 8.2											

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Saline River	Sm - 2.4	9:30 A Apr. 6	100	16	8.87	89.1	4.4	150	8.2	220	249	390
Bridge east of Salina (route U.S. 40)	"	9:17 A Apr. 13	80	12	8.73	80.4	3.6	75	8.1	190	236	600
	"	2:45 P Apr. 21	65	19	9.45	101.2	3.8	1,100	8.2	170	260	694
	"	10:40 A Apr. 29	85	19	7.85	84.0	3.1	430	8.1	200	277	705
	"	10:30 A May 5	380	17	7.16	73.5	3.9	2,400	7.9	2,800	218	799
	"	11:17 A May 19	65	23	7.19	82.8	3.2	930	8.0	130	256	344
	"	11:40 A June 15	55	25	6.58	78.6	5.5	-	8.4	700	206	212
	"	1:35 P June 29	1,000	24	3.63	42.6	7.1	-	7.5	1,700	82	16
	"	11:25 A July 13	900	25	4.46	53.2	2.7	-	7.7	4,000	111	39
	"	2:30 P Aug. 3	360	25	5.68	68.0	2.0	9,300	7.9	800	216	285
	"	11:30 A Aug. 17	150	27	5.53	68.5	2.2	9,300	7.8	1,300	166	210
	"	8:00 A Sept. 10	70	20	7.15	78.0	1.9	7,500	7.9	550	247	627
	"	11:50 A Sept. 30	65	16	7.08	71.2	2.0	15,000	7.8	270	282	730
	"	9:15 A Oct. 14	64	12	8.44	79.7	1.8	930	8.0	200	322	986
	"	8:45 A Nov. 3	100	12	6.10	56.3	4.6	43,000	8.0	1,100	169	550
	"	9:20 A Dec. 21	70	1	12.40	87.2	1.3	240	8.0	25	312	604
Saline River	Sm - 12.2	9:05 A Apr. 6	95	16	8.95	90.0	5.6	91	8.2	210	254	477
Bridge, U. S. Highway 81 north of Salina	"	8:53 A Apr. 13	76	11	9.22	83.2	3.1	750	8.2	150	236	688
	"	2:20 P Apr. 21	62	19	9.62	102.9	3.4	2,400	8.2	220	265	816
	"	11:08 A Apr. 29	80	19	8.37	89.5	3.8	930	8.1	210	282	863
	"	10:50 A May 5	360	17	7.10	72.9	4.2	4,300	8.0	2,400	172	640
	"	10:04 A May 19	60	22	7.03	89.7	3.3	2,400	8.2	190	234	397
	"	11:15 A June 15	50	25	6.55	78.2	5.5	-	8.4	400	199	267
	"	12:55 P June 29	950	25	4.36	52.1	8.0	-	7.4	3,200	123	102
	"	11:05 A July 13	860	26	4.50	54.7	3.2	-	7.6	7,000	121	57
	"	1:10 P Aug. 3	360	25	5.92	70.8	1.8	2,300	8.0	1,000	213	338
	"	10:25 A Aug. 17	165	27	5.50	68.2	2.3	12,000	7.9	1,200	190	318
	"	9:30 A Sept. 10	67	20	7.41	80.8	1.6	730	8.0	500	262	721
	"	1:15 P Sept. 30	56	17	5.42	55.7	2.6	11,000	7.9	230	296	975
	"	10:50 A Oct. 14	55	12	9.01	83.1	3.6	910	8.3	180	308	1,082
	"	10:05 A Nov. 3	85	12	6.90	63.7	4.6	43,000	8.1	800	214	900
	"	9:55 A Dec. 14	64	3	11.96	89.8	1.2	<300	8.0	25	315	910
	"	10:35 A Dec. 21	58	2	12.50	90.3	1.4	43	8.1	30	304	799
Saline River	Sm - 35.2	11:10 A Apr. 6	90	16	11.22	112.8	5.6	430	8.0	160	236	562
Bridge south of Culver	"	9:56 A Apr. 13	69	13	8.91	84.1	4.6	930	8.2	170	236	758
	"	1:40 P Apr. 21	55	19	9.00	96.3	4.2	210	8.3	170	256	893
	"	11:42 A Apr. 29	75	19	8.10	86.7	3.7	750	8.1	140	258	971
	"	11:45 A May 5	360	17	5.88	60.4	4.9	7,500	7.4	4,100	146	265
	"	9:35 A May 19	55	22	6.60	76.8	3.6	2,400	8.2	70	226	512
	"	2:40 P June 15	40	27	5.51	68.3	>5.5	-	7.9	350	207	474
	"	12:25 P June 29	1,960	23	2.69	31.0	12.8	-	7.5	6,000	94	101
	"	10:25 A July 13	730	25	5.06	60.4	3.6	-	7.7	7,000	116	80
	"	12:35 P Aug. 3	450	25	5.90	70.5	3.5	9,300	7.9	1,000	176	332

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Saline River	Sm - 35.2	9:50 A Aug. 17	400	26	5.89	71.6	2.9	3,900	7.9	1,100	204	496
Bridge south of Culver	"	9:55 A Sept. 10	64	20	6.61	72.1	3.0	910	8.0	500	259	835
	"	1:50 P Sept. 30	50	17	9.71	95.9	7.0	930	7.9	450	238	1,220
	"	11:25 A Oct. 14	49	11	9.69	87.4	3.8	230	8.2	270	277	1,322
	"	10:30 A Nov. 3	57	12	7.50	69.2	3.6	430	8.3	310	281	1,432
	"	10:25 A Dec. 14	58	3	12.03	89.4	1.4	43	8.1	25	296	924
	"	11:00 A Dec. 21	52	3	12.70	94.3	1.0	23	8.3	20	302	919
Saline River	Sm - 54.5	10:10 A Apr. 2	80	9	10.35	89.4	2.9	730	8.2	150	247	517
Bridge south of Tescott	"	10:25 A Apr. 13	63	13	9.38	88.5	4.9	2,400	8.2	150	232	864
	"	1:10 P Apr. 21	48	19	9.68	103.5	>7.8	11,000	8.3	120	267	950
	"	12:07 P Apr. 29	66	20	8.81	96.2	3.7	2,400	8.1	85	257	1,096
	"	12:15 P May 5	550	16	6.74	67.7	4.0	15,000	7.5	7,700	101	78
	"	9:06 A May 19	46	22	6.96	78.8	4.4	910	8.4	100	241	684
	"	3:05 P June 15	35	28	7.19	90.9	> 7.2	-	8.0	130	204	657
	"	11:55 A June 29	1,950	22	3.76	42.6	10.5	-	7.5	5,200	94	105
	"	10:00 A July 13	485	24	4.89	57.4	2.7	-	7.4	6,300	104	40
	"	12:05 P Aug. 3	910	22	3.99	45.2	13.2	> 110,000	7.7	2,100	128	238
	"	9:25 A Aug. 17	470	26	5.06	61.6	2.9	2,300	7.9	2,000	168	570
	"	10:50 A Sept. 10	60	20	6.98	76.1	3.9	72	8.0	400	256	930
	"	2:20 P Sept. 30	40	17	9.12	93.6	> 9.1	4,600	7.9	380	248	1,356
	"	11:55 A Oct. 14	39	12	9.30	85.8	3.8	< 300	8.3	220	282	1,380
	"	11:00 A Nov. 3	67	12	8.03	74.0	3.2	360	8.3	130	245	1,132
	"	10:50 A Dec. 14	48	3	12.34	91.6	2.2	91	8.0	20	285	886
	"	11:20 A Dec. 21	42	3	13.71	101.8	2.0	1,100	8.3	20	302	1,012
Saline River	Sm - 79.5	8:35 A May 19	34	21	5.98	66.6	4.6	1,500	8.2	60	249	1,016
County bridge at Rocky Ford	"	3:35 P June 15	250	20	2.24	24.5	7.6	-	7.4	7,500	78	127
	"	11:25 A June 29	1,800	22	2.98	33.7	10.9	-	7.3	7,200	98	32
	"	9:25 A July 13	375	26	5.79	70.5	1.2	-	7.8	4,600	141	78
	"	11:30 A Aug. 3	1,150	20	2.42	26.4	17.4	>110,000	7.7	2,800	68	56
	"	8:55 A Aug. 17	425	26	4.89	59.4	3.7	4,300	7.6	6,500	124	70
	"	11:35 A Sept. 10	65	21	7.30	81.2	5.4	910	8.1	320	249	1,091
	"	12:20 P Oct. 14	38	12	10.07	92.9	3.1	230	8.3	110	290	1,684
	"	11:25 A Nov. 3	40	12	8.23	75.9	3.7	910	8.1	100	212	908
	"	11:15 A Dec. 14	30	3	12.75	94.7	1.0	930	8.1	25	292	982
	"	11:50 A Dec. 21	25	3	14.33	106.4	1.4	210	8.3	25	304	1,042
Saline River	Sm - 87.4	9:35 A Apr. 2	65	9	11.00	95.1	2.4	360	8.2	140	238	757
State Highway 14, at Lincoln	"	10:58 A Apr. 13	47	14	9.63	92.9	4.0	1,500	8.2	150	230	1,073
	"	12:30 P Apr. 21	35	19	9.71	103.9	4.9	430	8.3	100	230	1,203
	"	12:33 P Apr. 29	50	20	8.50	92.8	4.1	290	8.3	120	240	1,308
	"	12:50 P May 5	410	17	7.01	72.0	6.0	110,000	7.8	7,500	152	230
	"	8:15 A May 19	31	21	7.07	78.7	4.8	430	8.3	110	236	972
	"	3:50 P June 15	550	23	4.43	51.2	11.2	-	7.2	4,000	77	22

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen		5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
					p.p.m.	% Sat.						
Saline River	Sa - 87.4	11:10 A June 29	2,300	22	3.34	37.8	12.4	-	7.3	6,000	99	58
State Highway 14, at Lincoln	"	8:55 A July 13	350	26	6.47	78.7	2.7	-	7.7	4,300	124	76
	"	10:50 A Aug. 3	200	24	6.40	75.1	1.7	3,600	7.9	1,800	140	205
	"	8:25 A Aug. 17	435	26	6.15	74.9	4.3	9,300	7.8	5,000	116	70
	"	12:00 N Sept.10	56	21	8.20	91.3	5.9	360	8.0	250	236	1,177
	"	2:55 P Sept.30	31	18	9.46	99.3	5.5	750	8.4	180	268	1,626
	"	12:45 P Oct. 14	31	14	10.29	99.3	3.2	36	8.4	190	277	1,596
	"	11:50 A Nov. 3	33	13	8.97	84.5	3.6	930	8.2	130	220	740
	"	11:35 A Dec. 14	28	3	13.07	97.1	1.4	230	8.2	20	304	1,132
	"	12:15 P Dec. 21	23	3	14.26	105.9	1.6	73	8.2	25	289	1,025
Saline River	Sa - 116.2	9:00 A Apr. 2	60	8	10.26	86.5	1.5	360	8.3	45	237	895
Bridge at Sylvan Grove	"	11:35 A Apr. 13	43	13	11.10	10[illegible] 7	2.2	4,600	8.2	25	236	1,254
	"	10:00 A Apr. 21	33	16	8.91	89.6	1.4	2,400	8.2	30	238	1,442
	"	1:03 P Apr. 29	36	18	10.62	111.3	2.5	2,400	8.3	40	225	1,100
	"	1:55 P May 5	110	17	7.79	80.0	3.3	15,000	8.1	2,500	180	740
	"	7:40 A May 19	26	19	6.65	71.2	2.3	300	8.2	60	232	1,223
	"	4:25 P June 15	850	22	3.17	35.9	7.3	-	7.6	8,000	79	65
	"	10:30 A June 29	2,800	22	2.70	30.6	12.9	-	7.3	10,000	102	40
	"	8:20 A July 13	180	26	6.15	74.8	2.1	-	8.0	1,000	163	220
	"	10:15 A Aug. 3	140	23	6.50	74.9	2.2	15,000	8.1	1,000	188	487
	"	7:50 A Aug. 17	310	25	5.56	66.4	3.4	24,000	7.7	4,400	111	60
	"	12:30 P Sept.10	48	21	9.42	104.9	4.1	300	8.2	100	224	1,282
	"	3:30 P Sept.30	28	17	11.78	120.8	1.8	4,600	8.4	20	255	1,784
	"	12:10 P Dec.14	28	3	12.15	90.3	0.9	46,000	8.3	25	296	1,302
Saline River	Sa - 124.2	8:45 A Apr. 2	55	8	13.25	111.6	6.5	91	8.2	30	228	562
County Bridge 3 miles west of	"	11:55 A Apr. 13	40	14	11.00	106.1	1.3	43	8.2	20	236	1,283
Sylvan Grove	"	9:40 A Apr. 21	30	14	9.31	89.9	1.3	43	8.2	20	256	1,479
	"	1:16 P Apr. 29	32	20	9.55	104.2	1.8	150	8.3	25	212	1,153
	"	2:10 P May 5	90	17	8.22	84.4	3.2	4,600	8.1	1,500	200	825
	"	7:25 A May 19	22	16	7.63	76.7	0.8	150	8.2	20	244	1,200
	"	4:45 P June 15	447	26	2.70	32.9	8.4	-	7.6	6,000	121	561
	"	10:15 A June 29	2,580	23	1.58	18.2	15.2	-	7.5	11,000	106	58
	"	8:00 A July 13	168	25	6.44	76.9	2.0	-	8.1	800	192	263
	"	9:50 A Aug. 3	130	23	7.55	87.1	2.4	9,300	8.4	800	190	383
	"	7:25 A Aug. 17	305	24	5.89	69.0	3.1	4,300	7.7	3,400	113	70
	"	12:50 P Sept.10	45	23	9.03	104.0	3.7	360	8.2	60	219	1,230
	"	4:00 P Sept.30	25	20	9.53	103.8	1.0	930	8.4	15	261	1,886
	"	12:25 P Dec.14	20	3	12.36	91.8	0.6	93	8.0	30	288	1,384
Saline River	Sa - 135.0	7:50 A Apr. 2	50	6	10.67	85.6	1.0	150	8.2	210	237	78
Bridge 1 mile east and 6 miles south of	"	12:20 P Apr. 13	36	17	12.29	126.4	1.6	210	8.2	20	240	1,330
Lucas	"	8:55 A Apr. 21	26	14	9.80	94.5	0.8	430	8.2	10	256	1,504
	"	1:35 P Apr. 29	27	20	10.35	113.0	1.6	91	8.3	15	240	1,316
	"	2:45 P May 5	83	17	8.44	86.7	3.5	4,600	8.2	1,400	200	841

KANSAS RIVER POLLUTION INVESTIGATION
LABORATORY DATA

SUMMARY OF INDIVIDUAL RESULTS

Sampling point	Mileage from Mouth	Date 1948	Ave. disch. c.f.s.	Temp. °C	Dissolved Oxygen p.p.m.	Dissolved Oxygen % Sat.	5-Day B.O.D. p.p.m.	Coliforms M.P.N. Per 100 ml.	pH	Turb. p.p.m.	Alkal. p.p.m.	Chloride p.p.m.
Saline River Bridge 1 mile east and 8 miles south of Lucas	Sa - 135.0	6:50 A May 19	17	18	7.10	74.6	0.9	91	8.2	25	262	1,246
	"	5:20 P June 15	371	24	2.49	29.2	8.9	-	7.6	9,500	95	136
	"	7:45 A June 29	2,330	22	2.04	23.1	17.4	-	7.5	8,200	96	35
	"	7:30 A July 13	160	24	6.43	75.4	1.6	-	8.0	800	143	290
	"	9:20 A Aug. 3	168	22	7.55	85.6	3.2	9,300	8.6	800	214	470
	"	7:00 A Aug.17	335	24	5.85	68.6	5.4	21,000	7.6	3,300	104	50
	"	1:25 P Sept.10	39	23	9.55	110.0	3.0	300	8.0	45	234	1,346
	"	4:20 P Sept.30	23	21	10.63	118.3	0.7	430	8.3	10	266	2,002
	"	1:00 P Dec.14	11	3	12.38	91.9	1.0	240	7.9	25	290	1,282
Saline River Bridge 7 miles north of Bunker Hill	Sa - 155.8	8:20 A Aug. 11	97	22	7.51	85.1	3.9	4,300	8.0	500	188	604
	"	6:50 A Sept.16	24	16	7.71	77.5	1.4	390	8.2	25	304	1,694
	"	9:10 A Dec. 15	25	3	12.47	92.5	2.4	91	7.9	10	296	1,236
Saline River Bridge - U. S. Highway #281 - 4 miles north of Russell	Sa - 166.6	8:40 A Aug. 4	420	18	6.03	63.2	>6.0	110,000	7.5	5,400	96	64
	"	1:50 P Sept.21	20	29	9.17	118.0	1.4	230	8.2	15	223	1,060
	"	3:10 P Oct. 19	15	16	11.73	118.0	1.5	430	8.3	5	243	1,330
	"	12:20 P Nov. 2	20	-	11.63	-	1.4	230	8.3	30	272	1,472
	"	11:55 A Dec. 8	25	3	13.25	98.4	4.3	91	8.1	25	239	736
Saline River Bridge - 2 miles east of Fairport	Sa - 186.9	9:30 A Aug. 11	80	23	7.92	91.4	2.0	4,300	8.6	360	177	172
	"	10:20 A Sept.16	22	20	8.99	98.2	1.1	91	8.0	10	178	444
	"	10:00 A Dec.15	22	4	12.62	96.2	2.4	930	8.0	10	209	236
Saline River Bridge - U. S. Highway 183 15 miles north of Hays	Sa - 220.1	1:35 P Aug. 4	280	22	7.69	87.2	4.0	46,000	7.9	550	171	40
	"	10:25 A Aug. 11	75	24	6.93	81.3	1.0	6,400	8.3	500	189	34
	"	11:25 A Sept.16	15	21	8.70	96.8	1.3	4,600	8.0	20	203	21
	"	10:35 A Dec. 15	20	2	12.77	92.2	0.8	930	8.0	25	214	24
Saline River Bridge - State Highway #18 - 11½ miles north of Ellis	Sa - 240.3	11:00 A Aug. 11	50	27	7.43	92.1	2.4	2,300	8.6	260	184	18
	"	12:05 P Sept.16	10	23	7.49	86.3	0.5	430	8.3	10	180	23
	"	12:15 P Dec.15	10	2	12.99	93.8	0.6	430	8.1	20	201	31
Saline River Bridge - U. S. Highway 283 - 5 miles north of WaKeeney	Sa - 268.3	12:40 P May 20	3	24	9.94	116.6	2.8	230	8.2	35	215	10
	"	12:20 P Aug.11	20	26	6.10	74.3	3.9	24,000	7.7	5,500	121	4.1
	"	12:50 P Sept.16	5	20	9.73	106.0	5.3	150	8.2	40	219	15
	"	1:50 P Dec.15	5	3	13.75	102.1	0.8	430	8.2	20	239	14

APPENDIX "I"

SAMPLING POINT DESIGNATIONS

To facilitate field designation and to simplify reporting and tabulation of data, systems of river mileages and stream abbreviations were utilized. Each river and creek was identified by its initial or abbreviated name and sampling stations located by the distance in river miles from the mouth of the stream. For example, index K-81.0 is the point on the Kansas River 81.0 miles from its mouth, R-125.2 is on the Republican River 125.2 miles upstream from its mouth and Sa.C.-3.6 is 3.6 miles from the mouth of Salt Creek. In cases where stream names in the same basin were duplicated, numerals were added for identification as, Mi.C.-#1 (Mill Creek) and Mi.C.-#2 (Mill Creek). Similar names in different basins were usually notated by different abbreviations as Be.C.- (Beaver Creek) and Bev.C.- (Beaver Creek). As shown in Appendix "H" river mile locations of stations on tributaries included the distances upstream to the mouths of the tributaries. For example, K-33.6, St.C.-16.0, To.C.-3.0 would indicate 33.6 miles up the Kansas River to Stranger Creek, 16.0 miles up Stranger Creek to Tonganoxie Creek and 3.0 miles up the latter creek to the station under consideration.

In addition, a description of the sampling point was also given using directions and distances from towns, numbered or unnumbered highways, or other easily identified reference points.

Stream designations used in this survey were as follows:

Stream Designations -(Tributaries indented in order of entry upstream.)

- M - Missouri River
- K - Kansas River
  - Tu.C.- Turkey Creek
  - Mi.C.#1 - Mill Creek
  - K.C.- Kill Creek
  - St.C.- Stranger Creek
    - To.C.- Tonganoxie Creek
  - W.- Wakarusa River
  - D.- Delaware River
    - Elk Cr.- Elk Creek
    - Gr.Cr.- Grasshopper Creek
  - S.C.- Soldier Creek
  - Mi.C.#2 - Mill Creek
  - V. - Vermillion River

- B - Big Blue River
  - B.V.- Black Vermillion River

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- L.B.- Little Blue River
    - Mi.C.#3 - Mill Creek
    - Ros.C.- Rose Creek
    - Sp.C.- Spring Creek
- B.I.C.- Big Indian Creek
- Tu.C.- Turkey Creek
- W.F.B.- West Fork Big Blue River
    - Bev.C. - Beaver Creek
    - S.B.W.F.B.- South Branch West Fork Blue River
- Pl.C.- Plum Creek
- Li.C.- Lincoln Creek
- N.B.B.- North Branch Blue River
    - Da.C.- Davis Creek

R - Republican River
- Sa.C.- Salt Creek
- Wo.C.- Wolf Creek
- Bu.C.- Buffalo Creek
- W.R.C.- White Rock Creek
- E.C.- Elm Creek
- Th.C.- Thompson Creek
- Tur.C.- Turkey Creek
- P.D.C.- Prairie Dog Creek
- S.C.- Sappa Creek
    - Be.C.- Beaver Creek
- M.C.- Medicine Creek
- R.W.C.- Red Willow Creek
- Bl.C.- Blackwood Creek
- F.R.- Frenchman River (Creek)
    - St.W.C.- Stinking Water Creek
- S.F.R.- South Fork Republican River
- Ro.C.- Rock Creek
- Buf.C.- Buffalo Creek
- A.- Arikaree River
- N.F.R.- North Fork Republican River

S.H. - Smoky Hill River
- Ly.C.- Lyons Creek
- F.C.- Fossil Creek
- Bi.C.- Big Creek

S - Solomon River
- N.F.S.- North Fork Solomon River
    - Be.C.- Beaver Creek
    - Ced.C.- Cedar Creek
    - D.C.- Deer Creek
- S.F.S.- South Fork Solomon River
    - Sd.C.- Sand Creek

Sa.- Saline River